MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 37 DECEMBER, 1930 Number 4

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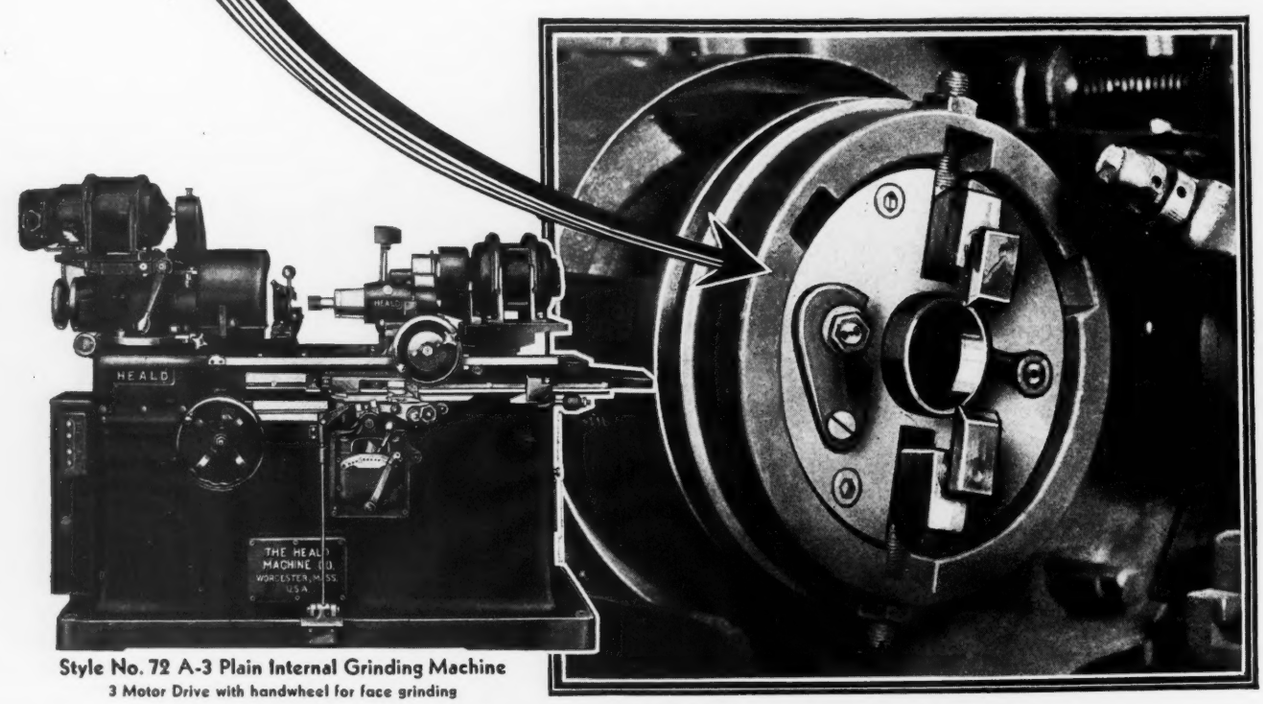

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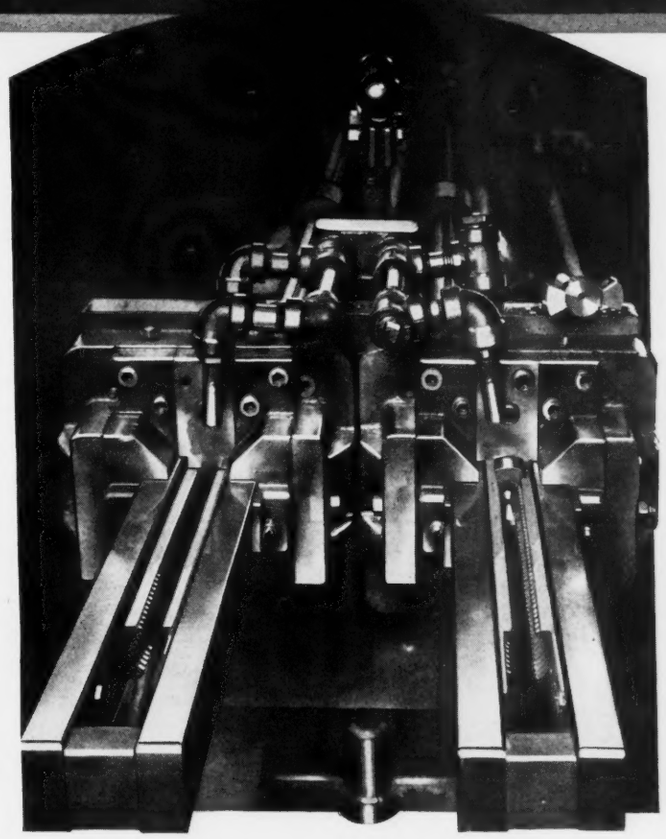
MACHINERY

Volume 37 NEW YORK, DECEMBER, 1930 Number 4

Recent Developments in External Broaching



Tools and Fixtures Used in Automotive Shops for Finishing Circular and Straight Surfaces of Shock Absorber Parts

By CHARLES O. HERB

BROACHES are being used in a number of plants for finishing the external surfaces, both cylindrical and flat, of the wings and wing shafts for automobile hydraulic shock absorbers. These parts are steel forgings. Hourly production rates up to 600 pieces for each ram of the broaching machines are obtainable by this method, together with the advantages of accuracy and low manufacturing costs.

The illustrations in this article show broaches and broaching fixtures designed and made by the Colonial Broach Co., Detroit, Mich., for the operations mentioned. The photographs show work being done in the Toledo, Ohio, plant of the Spicer Mfg. Co., while the drawings illustrate equipment used by other concerns for the same purpose.

Broaching Straight Surfaces of the Wings

On some wings, only the ends *W* (see view *B*, Fig. 1) are broached to length, whereas on others, surfaces *X* and *Y* are broached in the same operation. At the plant of the Spicer Mfg. Co., surfaces *X* and *Y* are milled after broaching. To broach the three surfaces at each end simultaneously, it is only necessary to employ broaches having teeth which are grooved the required distance, instead of being straight for the entire length. Broaches with grooves for finishing the three surfaces are indicated at *A*, Fig. 4. Fig. 2 shows an Oilgear double-ram machine equipped for broaching surfaces *X* (Fig. 1) only. In this illustration, the broaches of the left-hand ram are shown finishing a part, while the right-hand ram is being returned to the forward or loading position.

Approximately 1/16 inch of stock is removed from each end of the wings, the over-all length being held to between 2.755 and 2.760 inches. The surfaces broached are 7/8 inch long and 3/8 inch wide. The production per ram is 300 pieces per hour, or a total of 600 pieces per hour. A factor in obtaining this high rate is the use of automatic ejecting mechanisms.

Solid broaches are used for this job, as indicated at *A*, and they are 3 feet 2 1/4 inches long, the cutting portion being 22 1/2 inches long. Each part is located in the machine by means of the previously finished hole, which is seated on plug *B*, and its wing portions are held horizontally by the upright fingers of the spring-actuated block *C*. The broaches are held in proper alignment by guide blocks on the fixture. These blocks are adjustable to insure true paths for the tools.

Ejecting Mechanism Contained in the Broaching Fixtures

From Fig. 3 it will be seen that a long stud *D* is screwed into the back end of each plug *B* on which

the work is placed. Surrounding this stud there is a coil spring which is expanded when the work is placed on the plug, thus exerting pressure against a bar *E* to which the back ends of pins *F* are fastened. As the broaching ram reaches the end of its working stroke, rod *G* is drawn back, causing lever *H* to swivel on its pivot. This, in turn, pulls bar *E* forward against the action of the spring, and draws pins *F* toward the front, thus ejecting the work from plug *B* and locator *C*.

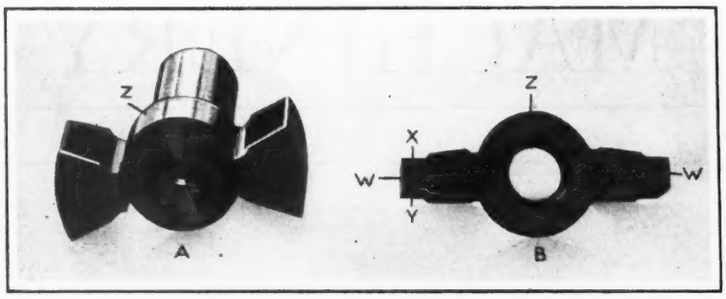


Fig. 1. Hydraulic Shock Absorber Parts on which Straight and Circular External Surfaces are Finished by Broaching

Broaching the Circular Portion of Both Parts

Equipment similar to that shown in the heading illustration is generally used for broaching the circular part *Z* (Fig. 1) of both the wings and wing shafts, although in the plant of the Spicer Mfg. Co., this operation on the wings is performed in the punch press illustrated in Fig. 8. In this case, the operation is of the push type, two broaches, 4 1/4 inches long, being employed.

The part is slipped over a stud to centralize it beneath the broaches and one of the wing portions is held in the slot of a block at the back of the cavity. On the return stroke of the ram, pins on the broach bars lift the work automatically out of the cavity, so that the operator can replace the finished parts with new pieces. This circular part is rough-milled prior to broaching at the Spicer Mfg. Co.'s plant, but in some other shops the circular surface is broached from the rough. Production on the broaching operation averages 500 pieces per hour. In performing this operation on a horizontal broaching machine, the parts are ejected by spring-actuated pins. The wing portions are held vertically.

The heading illustration shows the equipment used for wing shafts, these parts being broached to the specified size within a tolerance of 0.0015 inch, the same as the wings. Production averages 600 pieces per hour for the machine, or 300 pieces per ram.

It will be observed that when this photograph was taken, the broaches of the right-hand ram

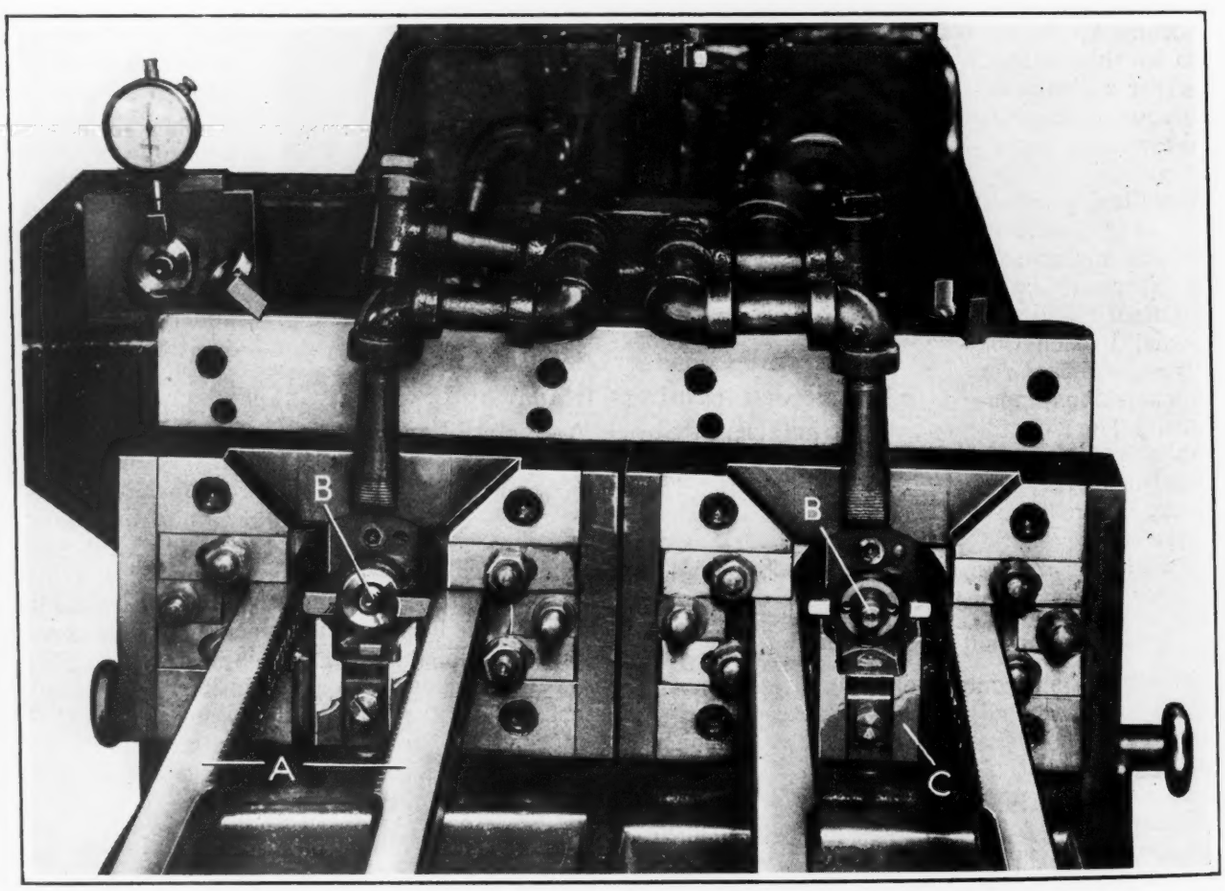


Fig. 2. Broaching Equipment Provided on a Duplex Hydraulically Operated Machine for Broaching the Ends of Shock Absorber Wings

were finishing a part, while the left-hand ram was returning to permit a new piece to be loaded, the finished piece having been ejected. Each broach used on this machine is made up of four sections, 3 1/2 inches long.

For this operation, the shaft of the part is slipped into a bushing at the center of the fixture and the lower wing is entered between the fingers of blocks

Ejecting Arrangement on the Broach Bars Themselves

Ejection of the wing shafts from the fixtures in which they are held for the operation shown in the heading illustration is accomplished by the application of a mechanism on the front end of the broach bars. From Fig. 6 it will be seen that this mechanism comprises spring-actuated fingers *E*

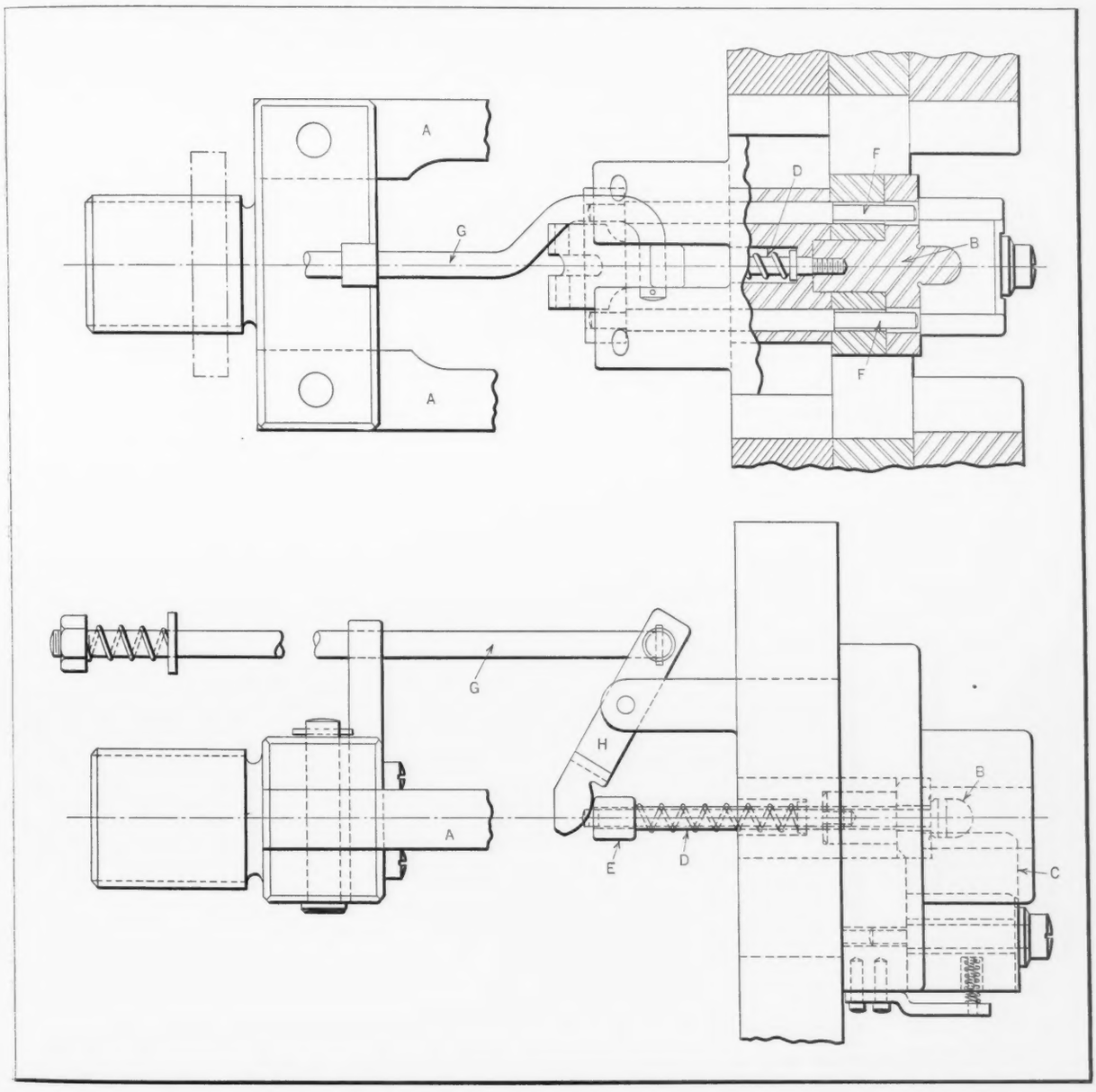


Fig. 3. Ejecting Mechanism Provided for Forcing Shock Absorber Wings from the Broaching Fixtures

B, Fig. 5. The broaches *A* are attached to bars *C*. These bars are guided by adjustable blocks on the fixture. With the exception of the means provided for holding and ejecting the work, the fixtures provided on horizontal machines for both wings and wing shafts are the same.

In some plants, rough- and finish-broaching cuts are taken on surfaces *Z* (Fig. 1) of both parts, and in other instances the surfaces are first form-milled and then finish-broached.

and *F*, which have shoulders *G* that normally project slightly above the low point of the broach cutting surfaces. When these fingers are pulled over the work as the broaches near the end of the working stroke, the springs beneath the fingers are compressed so that the work can pass shoulders *G*. Before the return stroke starts, however, the fingers are pushed into their normal position, so that the shoulders strike the wing shaft and push it from its bushing as the return stroke is continued.

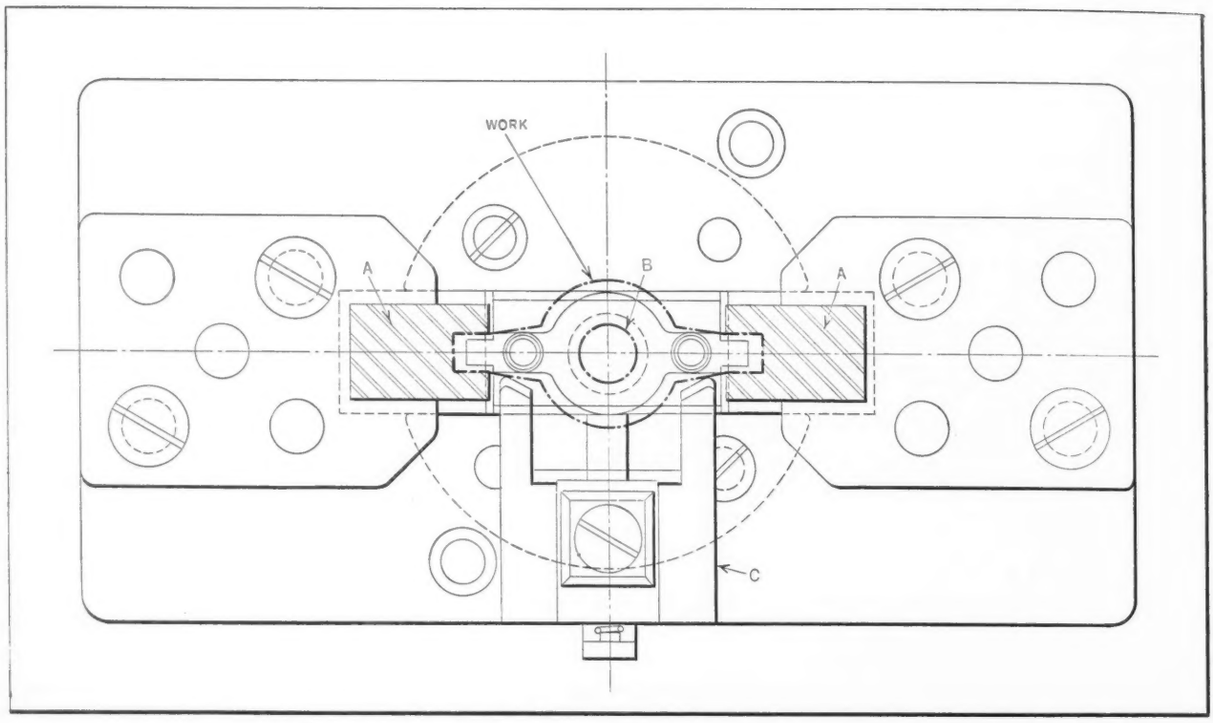


Fig. 4. Cross-sections of Broaches Used for Machining Surfaces W, X, and Y, Fig. 1, on Shock Absorber Wings

Ends of Four Wing Shafts Squared Simultaneously

In one shop, the ends of the wing shafts are squared by broaching. By the use of three broaches and the fixture illustrated in Figs. 7 and 9, two flats are broached on four parts simultaneously. The fixture is then indexed 90 degrees to bring the opposite sides of the shafts in line with the broaches. At the second working stroke of the broach ram, the parts are finished. Production averages 600 parts per hour with one fixture. A single-ram, hydraulically operated machine is employed.

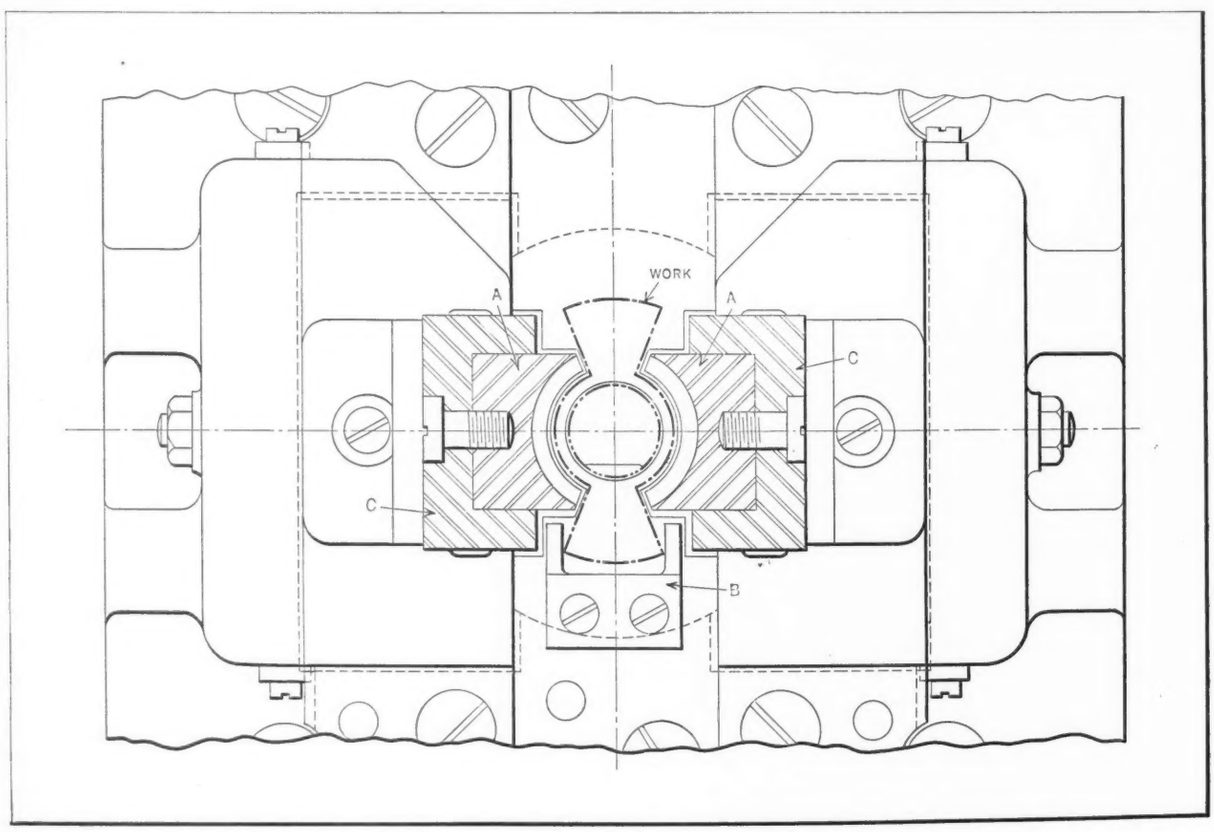


Fig. 5. Fixture Used in Broaching the Circular Surfaces Z, Fig. 1, of Wing Shafts

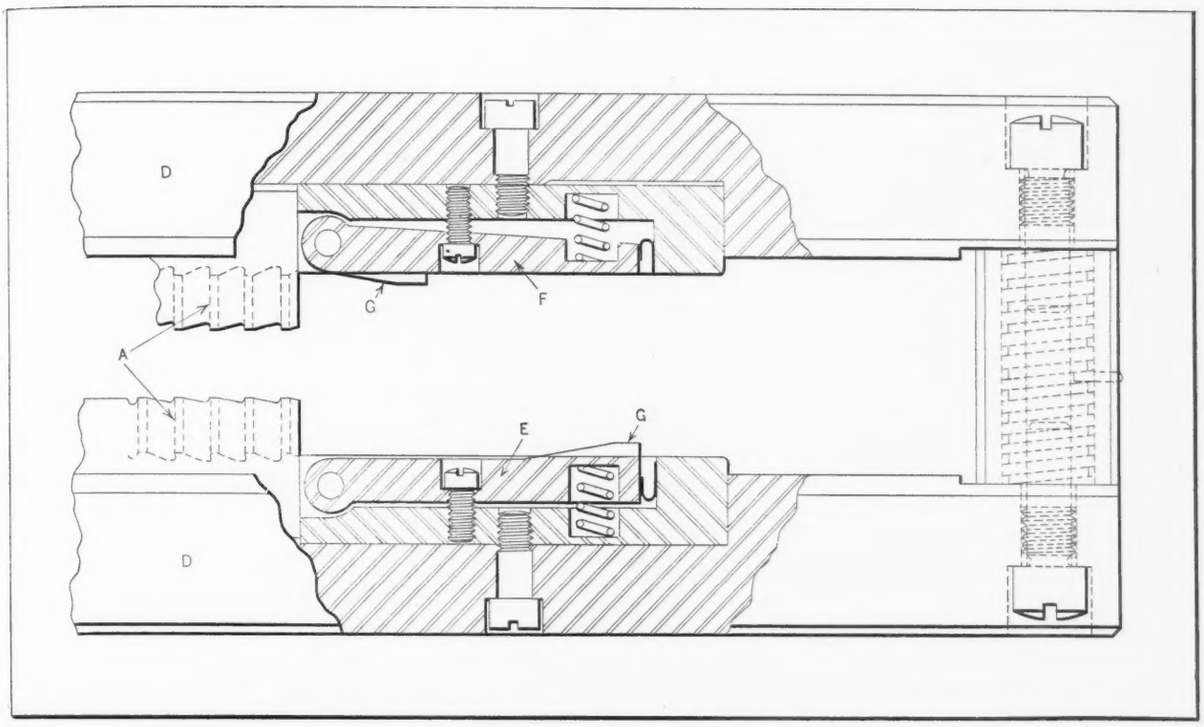


Fig. 6. Mechanism for Ejecting the Wing Shafts from the Broaching Fixtures

The arrangement of the four parts in the fixture is clearly shown in the plan view of Fig. 9 by the dot-and-dash lines. The broaches are indicated at *A*, *B*, and *C*, Fig. 7, which shows a front view of the fixture. It will be seen that broach *B* is of a double design, having teeth on both sides.

One of the features of this equipment is that the top part of the fixture is raised at the end of each operation, so that the broaches clear the work pieces during the return stroke. This is accomplished by turning handle *D* to actuate gear *E*. The gear meshes with a rack *H* fastened to slide *F* which contains bushings *G* in which the wing shafts are seated. Consequently, as the gear pulls rack *H* toward the right, the top unit of the fixture is pulled in the same direction up an incline of the fixture base until the top surface reaches the position indicated by the dot-and-dash lines in the lower view, Fig. 9. The fixture is reloaded in the raised position and is then lowered into the working position.

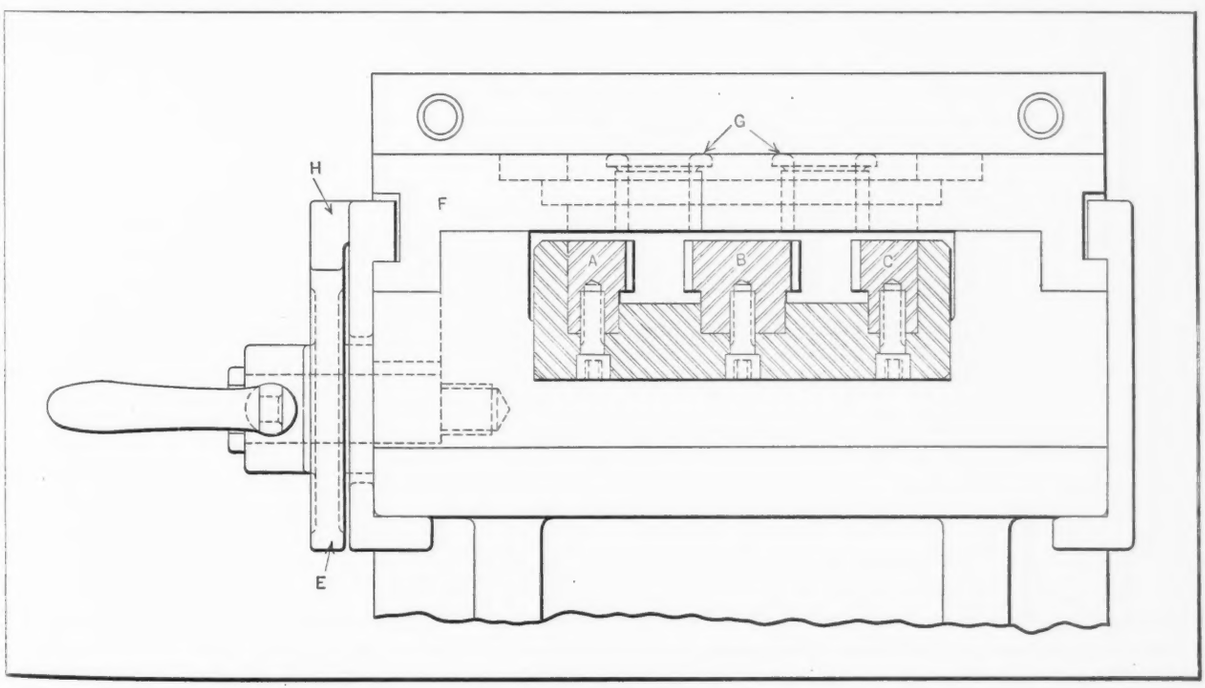


Fig. 7. Front View of Fixture Illustrated in Fig. 9, Showing a Cross-section of the Three Broaches and Bar in which They are Held

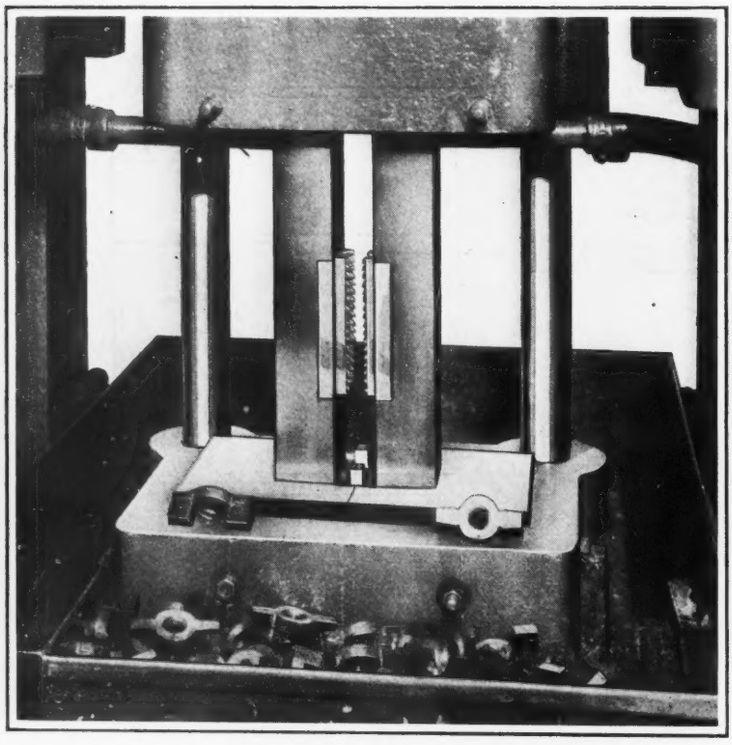


Fig. 8. Punch Press Set up for Broaching the Circular Surfaces of Shock Absorber Wings at the Rate of 500 Parts per Hour

When the parts are placed in bushings *G*, lugs on spider block *K* insure that the wing portions will point in the directions shown in the plan view. Then handle *J* is operated to rotate a plate *L* in which there are four cam grooves. Pins fastened to locking blades *M* ride in these grooves, and as plate *L* is turned, the locking blades are wedged firmly against one side of each wing shaft, forcing the opposite side against block *K*.

Indexing of the fixture is effected by manipulating handle *N*, which pulls plunger *O* from slots *P* in the bushing plate, and then turning the bushing plate by hand. Slots *P* insure accurate indexing of the bushing plate to 90-degree positions.

* * *

STOPPING CRACKS IN SHEET METAL

By A. EYLES

Excessive vibration is the principal cause of cracks in sheet-metal products and components. The continuous bending to and fro of the fibers causes them to crystallize and finally fracture. An effective method of preventing cracks in sheet metal from enlarging or extending is to drill a small hole through the metal at the extreme end of the crack. The hole should be so located that about three-fourths of the drill will cut beyond the end of the crack in the sound metal. This method should be followed even when a sheet-metal patch is riveted over the crack, as otherwise the crack will ultimately creep or extend beyond the patched area. Oxy-acetylene welding, however, provides an ideal method of stopping cracks in sheet-metal products, as the metal is annealed by the torch flame which welds the fibers together.

SOME CHARACTERISTICS OF STAINLESS STEEL

According to a paper read by Earl Smith, of the Republic Steel Corporation, before the American Drop Forging Institute, surface imperfections, either in the form of seams or imperfections due to forging, are very serious when they occur in stainless steel. The scale that forms on the surface of stainless steel is similar in its chemical composition to ordinary forging scale. As is well known, ordinary forging scale decomposes in moist air, water, and weak acid, forming rust. Scale in seams or in rough surfaces due to cracks, laps, or other forging defects, if not absolutely removed, is therefore likely to start a rust spot. It is surprising to note how much rust can stain the surface of a stainless steel forging from a lap so fine that the eye will not detect it on a pickled or sand-blasted forging. The rust will not attack the stainless steel itself, but the appearance of the forging is not satisfactory.

The treatment of stainless steel varies with the service for which the part is intended. The widest use at the present time is in the cutlery field. Cutlery steel is usually composed of 0.30 per cent carbon and 13 per cent chromium. It must have a Brinell hardness of about 500. To obtain this hardness, the material is heated to about 1800 degrees F., quenched in oil, and drawn; the proper drawing temperature ranges from 400 to 900 degrees F.

When definite physical properties are desired for mechanical strength, preliminary working of the material becomes an important factor. In machinery construction, the impact properties of stainless steel depend not only upon the composition and heat-treatment, but also, to a large degree, upon the skilled workmanship.

* * *

Micromotion is a method of job analysis employing a motion picture of the job having a specially arranged clock-timing device which is in view when the picture is taken, so that the timing device is recorded in the picture. The time-clock has a hand revolving at 20 revolutions per minute and the face is divided into 100 divisions. As the film records all motions made by the operator, together with the position of the hand of the clock, it is possible by projecting each picture separately, to observe any or all of the motions individually, together with the time required; and the accuracy of the study may be as close as one two-thousandth of a minute. "It is generally believed," says R. M. Blakelock of the Wage Rate Department of the General Electric Co., "that while this method is unique, it is not practicable for everyday job analysis; but the micromotion method has been found to be not only practical, but essential in modern job analysis."

CODE OF ETHICS FOR FOREMEN

The National Association of Foremen, with headquarters in the U. B. Bldg., Dayton, Ohio, has adopted the following code for foremen. This code will prove of interest to all foremen, whether they are members of the Association or not, as it expresses ideals toward which all foremanship ought to be directed.

1. The foreman should recognize that every man above, beside, or below him has an inherent desire to do good work and to be a useful and respected citizen. He should not assume that any man wants to do anything less than his best until he has considered every other possible motive.

2. The foreman should keep an open mind on all subjects, striving to maintain a broad and balanced outlook and being always willing to recognize merit in another's ideas.

3. The foreman should deal fairly with the management, the men, and other foremen, assuming responsibility for his own mistakes and refraining from shifting blame to others.

4. The foreman should strive to understand the principles of business which make for success or failure of industry. He should pass at least some of the fundamentals of business principles along to his men, so they can see their own relation to the general scheme.

5. The foreman should keep informed as to the latest developments in equipment and processes. He should recommend or put into effect such methods as will produce improved quality, lower costs for the product, and better working conditions.

6. The foreman should regard his profession as a field of social service offering an opportunity to help working people obtain maximum satisfaction from life.

7. The foreman should endeavor to earn, and carefully guard, a reputation for good moral character, good citizenship, and honesty, and to support and promote the uplifting influences of the community.

* * *

A poor standard is often better than no standard.

CULTURAL STUDIES FOR ENGINEERS

In an address made by Alfred R. Glancy, president of the Oakland Motor Car Co., at Lehigh University, the importance of cultural studies in engineering schools was emphasized. "Industry," Mr. Glancy said, "is asking for men with personality, thoroughly trained in the fundamentals." He suggested that the colleges make an effort to develop personality in so far as this can be done. The poise that general culture gives is of importance in any branch of industry, because the man who makes a good impression, other things being equal, goes further than the one who does not. He also emphasized the fact that beauty of design has become more and more an important factor in engineering, and that cultural subjects that influence the engineer's appreciation of beauty, should be encouraged.

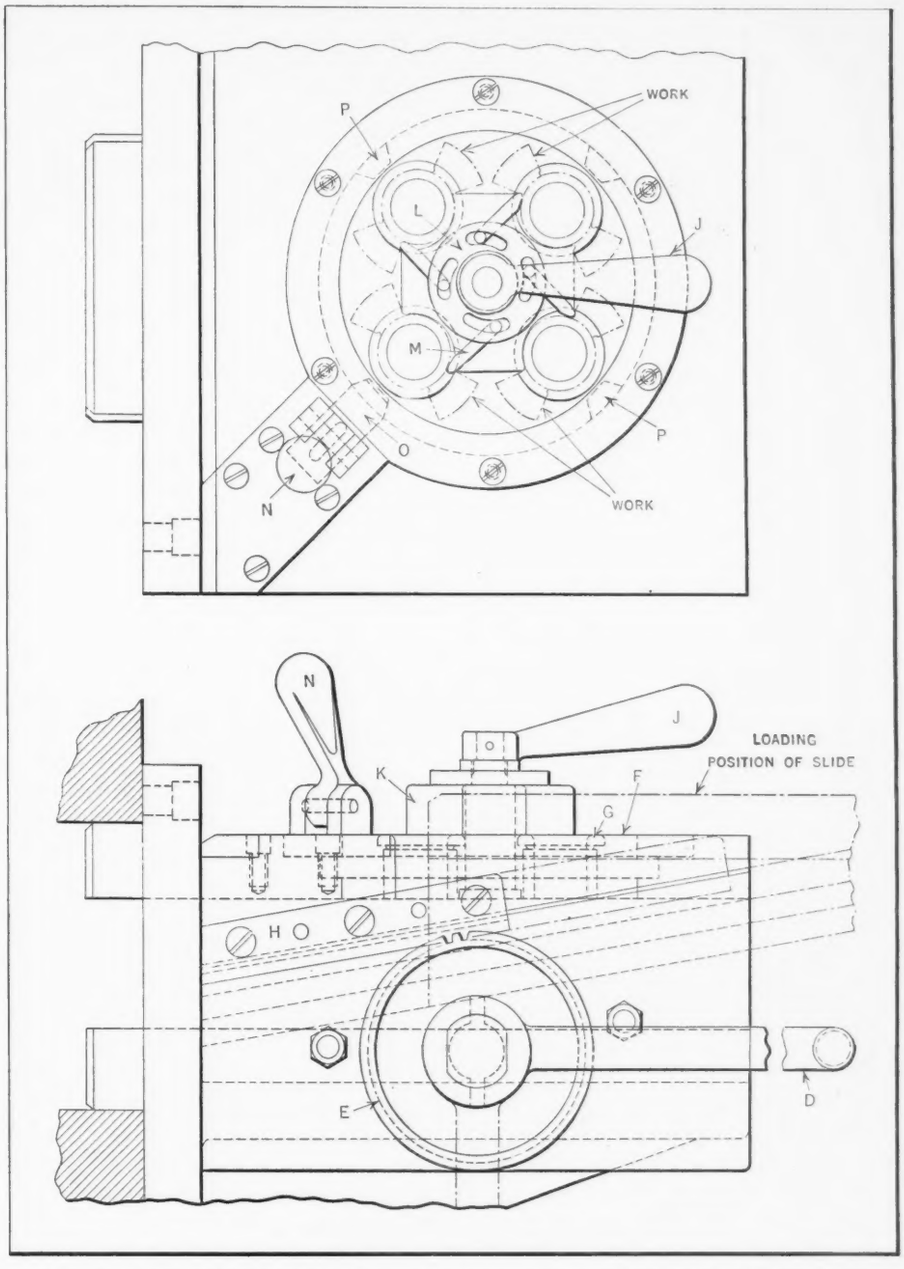


Fig. 9. Fixture Employed for Broaching Squares on the Shank End of Four Wing Shafts Simultaneously

The Shop Executive and His Job

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

WHO SELECTS NEW MACHINERY?

Commenting on the article "Who Selects New Shop Equipment?" in November MACHINERY, I would like to refer to a case where a new machine of a certain type was being considered. The master mechanic went out into the department where machines of this type were used, and talked a few minutes to each of the operators. In this way, he learned that it was very difficult to shift speeds on the machine under consideration. When the machine was cold, the oil clogged, and it took a long time before the machine would function properly. The machine was a little too wide for a man of ordinary build to reach across, which was necessary at times in its operation. It was so constructed that it took a little longer to set up than some other makes of the same type.

The master mechanic checked over this information with the foreman and found it to be correct. During the conversations with the shop men he was also offered many ideas as to the best machine of the type being considered. There was one machine on which most of the men agreed. As a result, that machine was thoroughly investigated and was finally purchased. The opinion of the shop men was found to be correct after the machine had been installed, and more of the same make were purchased later.

At the present time no machine is bought by this company without consulting the men who operate the same type of machine. It has proved to be a distinct advantage, and as a result very few unsatisfactory machines have been bought. It is perfectly reasonable to assume that the man who operates a machine should know something about its advantages and disadvantages.

CHARLES R. WHITEHOUSE

WHO SHOULD GOVERN SHOP PURCHASES?

The purchasing department, if not assisted by the shop, does not always buy the most economical material, but simply the cheapest. On the other hand, it is not always wise to let the shop govern purchases completely, because the shop man generally thinks in terms of brands or trade names; and when he has once found a satisfactory source of supply, he is inclined to want that particular brand, irrespective of price. Also, he is mainly interested in the ease of manufacture, and the type of material that gives the lowest machining cost appeals to him most.

If the firm has an efficient engineering department, the opinion of that department should be used as a balance wheel for the ideas of the purchasing department and the shop. The engineering department can prepare a material specification, giving all the properties required of the tools or materials to be bought. After these requirements have been met, price becomes the next question.

If there is no engineering department that can do this work, however, the shop can generally be trusted to select the right equipment and materials. The shop is responsible for the finished product and should have some control over the means of obtaining it.

JOSEPH BELL

SHOULD PRODUCTION MACHINERY BE SOLD ON TIME PAYMENTS?

In times of depression, it is logical for manufacturers to make a careful inventory of their machine equipment and install new machinery where necessary. Unfortunately, it is also the time when ready cash with which to pay for new machines is scarce. It seems to me that it would be perfectly logical to allow a manufacturer with a well established business to secure his equipment on time payments.

After all, the practice of renting machine equipment, the machine manufacturer retaining title, is only another method of deferred payments. The machine manufacturer may be better protected than in the ordinary time payment plan, but the principle is the same. Of course, proper financing charges on deferred payment sales should be included in the selling price.

CHARLES KLYNE

CHECKING DRAWINGS

In the article "Who Should Check Drawings?" on page 92 of October MACHINERY, the author says, "I have still to find a draftsman who makes a perfect drawing." To this I would like to add, "I have still to find a checker who can find all the mistakes of the draftsman." If the checker is acquainted with the men whose drawings he is checking, his job is simple and he will find a great many mistakes in a very short time; but if the checker does not know the men, he does not know what kind of mistakes they are likely to make and his task is more difficult.

In my experience, I have found that men who can be relied upon to design and detail a complicated piece of machinery correctly are likely to make serious mistakes in solving a simple triangle. On the other hand, I once knew a man whose fixtures were always so designed that the part to be operated upon could not be put into them, and if it went in, it could not be taken out again; but if

his work involved any calculations, there was no need of checking them. They were invariably correct.

I am mentioning this merely to indicate that a checker who can look only for the kind of mistakes that a certain draftsman is most likely to make will find most of the mistakes he is looking for, in addition to a number that he is not looking for; while a checker who is merely looking for mistakes without knowing anything about the characteristics of the man whose drawing he is checking is likely to overlook quite a few of the errors.

With all this in mind, I would say that whether or not the drawing should be checked minutely depends on who has made it. With some draftsmen, it may be all right to say, "Go ahead and build the job." With others, I would spend about as much time on checking as they did in making the drawing, and then I would say, "I hope it is right."

EDWARD HELLER

ONCE MORE THE PUNCTUALITY BONUS

Almost every angle of the punctuality bonus has been discussed in MACHINERY except one. I would like to make some comment on this point. The foreman, the man who operates an automatic machine, the switchboard operator, the man who works in an assembly line, and the inspector cannot render the service for which they are paid unless they are punctual. They must be on the job if everything is to function in the shop. To pay them a bonus, as has already been said, amounts to a duplication of payment of wages. A penalty for tardiness should rather be the rule.

On the other hand, consider the man who works under the incentive wage system. Generally, any man with normal skill and experience is able to "catch up" five, ten, or fifteen minutes a day without harming his work or affecting the efficiency of the plant. Such a man would be able to start five minutes late and quit five minutes early and yet render the service for which he is paid; but it would be bad for the discipline in any department to have the men free to do so. It is obvious that in this case punctuality is independent of the service paid for, and may well be encouraged and paid for separately by a suitable bonus.

However, the combination of a bonus and a penalty is a difficult thing to establish in most plants, and may do more harm than good.

FRANK M. GULLAND

GOOD SHOP CONDITIONS REDUCE LABOR TURNOVER

What consideration does a prospective employe give to the working conditions prevailing in the plant in which he seeks employment? Apparently, he is mostly concerned with the amount of wages paid. But, if the truth were known, we would find that in most cases one of the prime motives for wishing to make a change is a desire to work in an attractive environment. Great strides are being made by many large concerns in improving shop conditions, and many of the smaller plants are also falling in line.

One concern attributes its unusually small labor turnover to the exceptionally good working conditions in the shop. The highest wages are not paid there, yet this shop is not troubled with a shortage of skilled or unskilled labor. The installation of a cafeteria, improvements in sanitary conditions, the use of the suggestion box, the inauguration of the employes' council through which differences are ironed out, and many other means are employed by this concern in order to keep its men contented. This would seem to indicate that working conditions are actually of prime importance to the employe.

J. E. F.

SETTING THE RATE FOR A NEW MAN

New men should not be paid a higher rate than older employes unless it can be clearly demonstrated, to the satisfaction of the older employes, that the newcomer is more valuable than any of them. Even when the management feels that this could easily be proved, it is a better policy to pay the new man at a rate slightly lower than that paid to the older men, and then advance him rapidly if he demonstrates his ability to the satisfaction of all concerned.

OBSERVER

SHOULD PRODUCTION BE GUARANTEED?

Commenting on the editorial "Should Production be Guaranteed?" on page 98 of October MACHINERY, the writer believes that instead of a production guarantee, the manufacturer of the equipment to be sold should merely make an estimate of the production and then demonstrate the machine in operation, either in his own plant or in the plant of some customer who has bought the machine in the past. The buyer then has an opportunity to check the estimate with his own observations. He has seen what the machine will do in other shops, and there is no reason why it should not do as well in his own, provided the conditions surrounding the machine in his shop are equally advantageous.

If the machine is ordered after the buyer has seen it in operation, he assumes part of the responsibility for its success, as this vindicates his judgment. Instead of throwing all the responsibility on the machine manufacturer, it is likely that every effort will be made to prove the machine a success. Improvements may be suggested by the buyer's own engineers.

With the small tolerances and the finish required today, it is sometimes impossible to estimate exactly what the machine will do until it is set up and working under the factory conditions of the buyer. It is unreasonable, therefore, to ask for production guarantees, and many machine tool buyers recognize this fact.

JOSEPH BELL

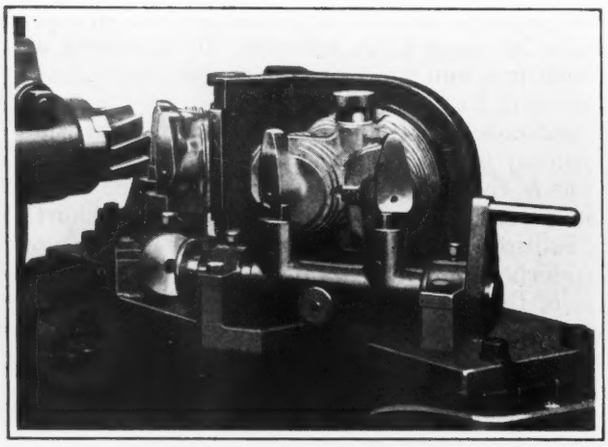


Fig. 1. Milling Two Surfaces in One Operation with Two Settings of the Work

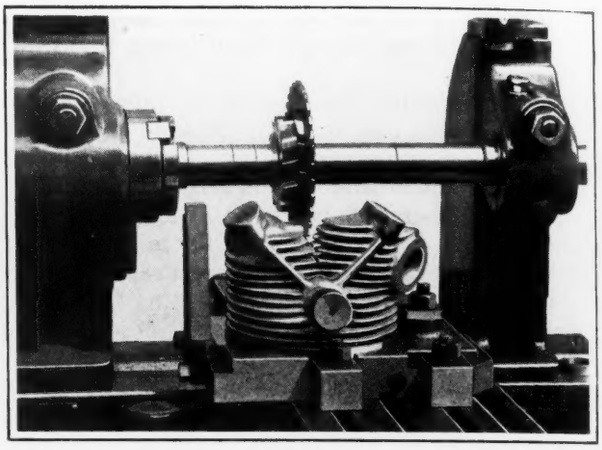


Fig. 2. Milling the Clip Pad and Slotting the Fins in a Simple Plate Fixture

Milling Practice for Limited Production

When the Output is Small or Changes in the Design of the Product Occur Often, Milling Equipment Should be Selected with These Conditions in Mind

STANDARD machines and special fixtures, as a rule, are the most advantageous combination for milling operations in plants where production is limited. This combination is especially applicable in aircraft engine plants where a comparatively few engines are built in each lot, and where, with the present rapid progress in aircraft practice, frequent changes in engine design are likely to be made. Obviously, a large expenditure for special machines would be false economy in that case.

As an example of the advantageous use of standard machines and special milling fixtures, the present article will show some of the milling operations on the Lycoming aircraft engine as performed on Cincinnati milling machines of the plain and duplex types. Many of the fixtures used in this plant are so designed that they can be employed for more than one part; and in some cases, especially on small work, they are built so that when production requirements increase, another fixture can be added on the same index-base. This allows the operator to load one fixture while the part held in the other is being milled, thus increasing production about 40 per cent.

Continuous Milling of Two Angular Surfaces

A typical example of simple fixture design is illustrated in Fig. 1. Two aluminum cylinder heads on which two pad surfaces are being milled are

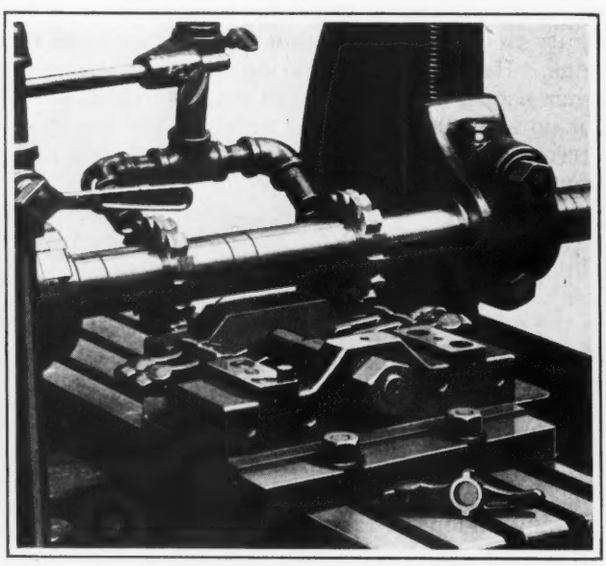


Fig. 3. Fixture in which Four Rocker Arms are Clamped by One Bolt

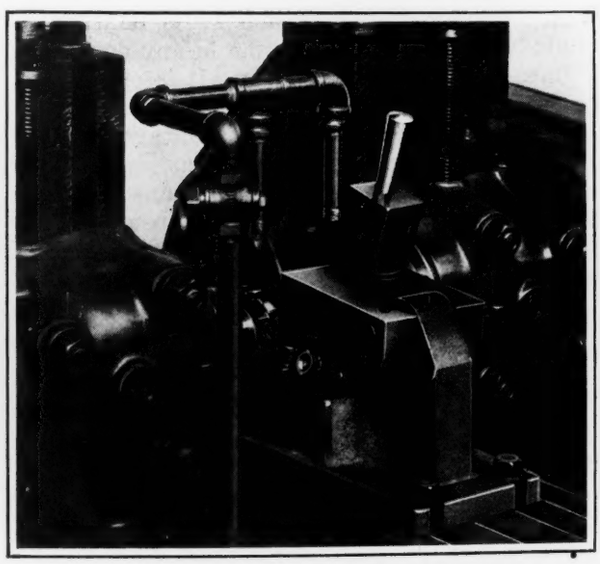


Fig. 4. Fixture with Quick-acting Clamp for Holding Rocker Arms

held in this fixture. The heads are located centrally by a stud in the angular-shaped fixture base. They are located radially by a removable plug which passes through the cross-hole in the head and into a corresponding hole in the fixture.

The two overhanging ends of each head are supported by means of spring plungers under the edge of each pad. These plungers are cut away to clear the cutter and are a slip fit in a bracket hinged at the lower part of the fixture. This design permits the plungers to be swung away from the work so that there will be sufficient room to remove the head from the fixture. To swing the bracket away from the head, the operator grasps the crank-handle and moves it to the left. Provision is made for locking the plungers when the work is in position.

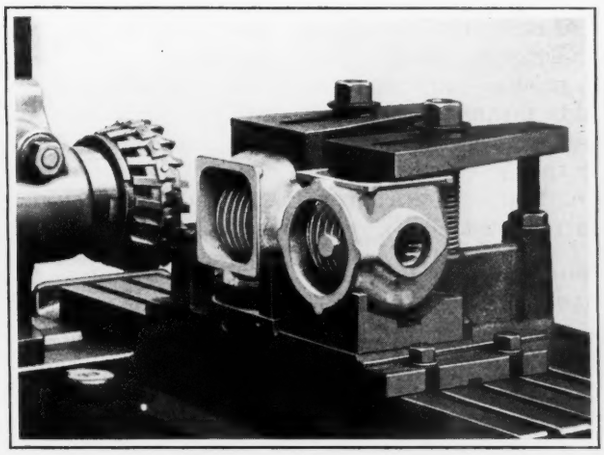


Fig. 5. Simple Fixture in which Two Faces are Milled at Right Angles to Each Other in Two Settings

As shown, the head at the left is in position for milling. While this head is being milled, another head is loaded in the fixture at the right, so that after the first head is completed, the table is fed along to the correct position for milling the other one. While the second head is being milled, the first one is removed from the fixture, but is reloaded later at the right-hand position, for milling the other pad. The table feed used on this job is 11.3 inches per minute, and the production time is 1.91 minutes. Approximately 1/8 inch of stock is removed.

Another operation on the cylinder head (milling the clip pad and sawing a slot between the cylinders) is performed in the same type of machine, as illustrated in Fig. 2. The fixture consists merely of a flat plate bolted to the table, having a stud over which the head is centered. Although of simple design, this type of fixture has many uses in connection with other machining operations on the heads.

Form-milling Pivot Boss on Rocker Arm

Fig. 3 shows how the curved surface on the pivot boss of a rocker arm is form-milled to a radius of 1.125 inches. These arms are made from steel forgings. When assembled in the engine, the surfaces milled serve as an oil seal for the arm. Four arms are held in the fixture at one time. The hubs have been straddle-milled in a previous operation, and are located over two hardened studs secured in the fixture. The hubs are clamped rigidly against a stationary block by means of a bolt passing through the center of the fixture. An equalizing arrangement on the end of this bolt transmits the same pressure to each set of arms. With a feed of 5.1 inches per minute, the time required to mill each of these pieces on both si les is 0.58 minute; approximately 1/8 inch of stock is removed.

Fixture Designed for Increased Production if Required at a Later Date

The fixture shown in Fig. 4 for milling the slot in the rocker arm was designed to be used with a duplicate fixture on an index-base for continuous milling. As shown, however, it is being used separately on a duplex milling machine for milling two rocker arms during each cycle. The arms are located over two studs secured in each side of the fixture. Radial movement is prevented by station-

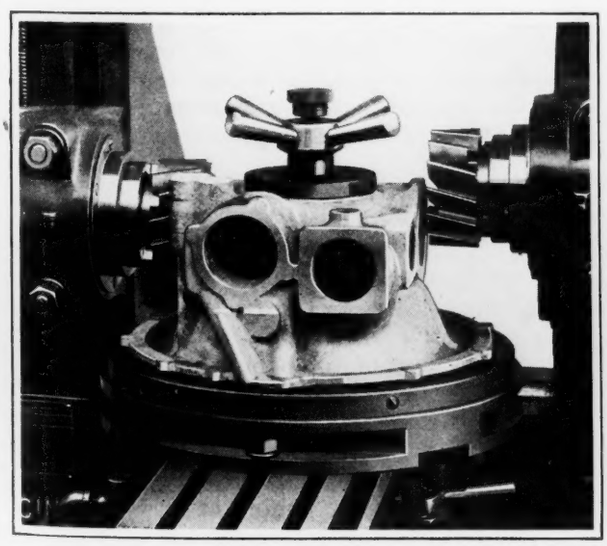


Fig. 6. Another Simple Plate Type of Fixture which can be Adapted to Many Jobs

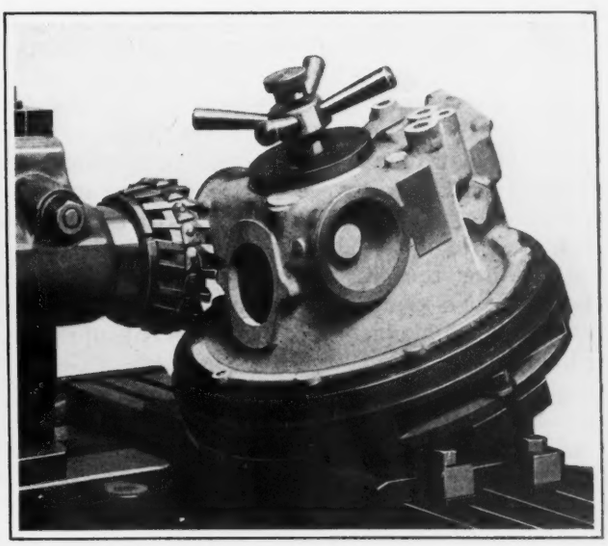


Fig. 7. Milling an Angular Face on the Housing in the Fixture Shown in Fig. 6

ary studs, on which one end of each arm is clamped securely by means of a cam-actuated clamp.

Adjustment of the cam to produce varying pressures on the work is obtained by means of a spanner nut located below the cam-lever. A feed of 3.12 inches per minute is used on this job, and the time required for each piece is 0.34 minute. Approximately 1/8 inch of stock is removed.

Adapting a Simple Fixture for More than One Operation

The pads on accessory drive housings are milled in a duplex miller with the set-up shown in Fig. 6. A round plate, bolted to the machine table, is used for supporting the work. The work is fastened to the plate by a removable clamping arrangement consisting of a T-bolt with a pilot wheel and knurled knob at the top.

The pilot wheel serves as a nut, while the knurled knob is securely pinned to the T-bolt. When the work is centered in the fixture, the T-bolt is lowered through the housing until it engages a slot in the fixture. The bolt is then adjusted in the slot by means of the knob, after which the pilot wheel nut is screwed down tightly. For the first milling cut, the work is located by a pin which enters one of the bolt holes in the casting.

In the second milling operation, the fixture is reset on the machine table 90 degrees from the original position. The casti g is again clamped to the fixture as previously described. The feed used in this case is 11.3 inches per minute for both operations. The production time on each operation is two minutes for rough-milling and the same for finishing.

This fixture is also used for the rough- and finish-milling operations on the angle pads on the housings. However, in order to hold the casting at the proper angle, it was necessary to make an angular base on which the original fixture could be bolted securely. (See Fig. 7.) The work rests on buttons and is located by a ring in the fixture which engages a turned flange on the casting. In this case, also, the work is located radially by a pin in the fixture, engaging a hole in the work.

All the other details of operation are similar to those described in connection with the operation shown in Fig. 6. The production time is 4 minutes for each piece; approximately 1/8 inch of stock is removed.

Milling Two Faces at 90 Degrees in Two Settings

The operation shown in Fig. 5 is interesting because two different faces on two pieces are milled simultaneously. The piece being milled is a carburetor heater body, and is an aluminum casting. A feed of 8.3 inches per minute is used on this job, and the time for completing each piece is 2.8 minutes, about 3/32 inch of stock being removed. It will be seen that the piece at the right is located by means of V-blocks and clamped securely by straps. There is nothing unusual about the design of this fixture, but it is interesting to note that the work is held in such a way that both the round and square pads, which are at right angles to each other, can be milled in one operation.

Industrial Conditions in Sweden

Some impressions from a recent visit to Sweden are given in a letter just received from Edwin Karlson of Cleveland, Ohio, for many years factory manager of the Chandler-Cleveland Motors Corporation, and until recently vice-president in charge of manufacturing of the Peerless Motor Car Corporation. Mr. Karlson was much impressed by the apparently prosperous conditions of the Swedish industries. He found that wherever production was of a sufficient quantity to warrant it, modern manufacturing methods were used; and even many of the smaller plants gave evidence of their alertness in the use of up-to-date tools and methods.

One thing that particularly impressed him was the headway made by German machine tools in Sweden since his last visit in 1925. A leading machine tool importer stated that the sales of German machine tools were due largely to their low price, as compared with American machines, and to the credit terms of German machine tool manufacturers. However, American small tools seem to hold their own exceptionally well, even in competition with lower priced European products, and American drills and other small tools are looked upon with great favor.

Rapid strides have been made in the efforts to improve working conditions and raise the standards of living, and as a result, the number of people emigrating from the country is very small at present.

As most of the products of the Swedish machinery industries do not find a sufficient market at home, that country has become an exporting nation of considerable importance in the world's market.

* * *

The first of two electric freight and switching locomotives of somewhat unusual design was recently shipped from the Erie, Pa., works of the General Electric Co. to the Lackawanna Railroad. These locomotives are of the trolley, oil-electric, battery type, capable of operating either from a 3000-volt direct-current trolley, from an oil engine, or from a battery. Operation, when outside the electric zone, will normally be with a 300-horsepower Ingersoll-Rand oil engine and battery jointly supplying power. The engine is direct-connected to a 750-volt direct-current generator, which is used both to charge the storage battery and to supply power to the traction motors.

Application of Roll Type Thread Gages

How "Go" and "Not Go" Thread Gages with Annular Ribbed Rolls are Constructed and Applied to Insure Interchangeability

By C. V. JOHNSON

THE function of a limit thread snap gage is to facilitate the production of interchangeable and dependable threaded parts. It should serve as a means of preventing the production of faulty threads rather than as a means of detecting and rejecting inaccurate work.

Interchangeability is primarily an economical requisite which eliminates the necessity of fitting mating parts. It is controlled by the "Go" gage.

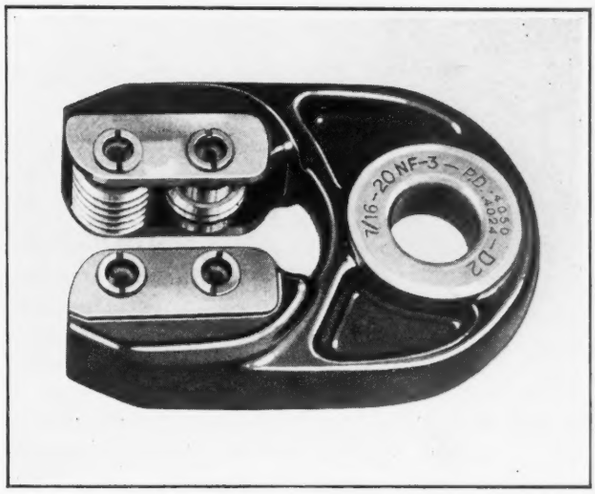


Fig. 1. Roll Type Thread Gage, Showing Arrangement of Gaging Elements

Dependability is fundamentally a mechanical consideration, and is contingent upon accuracy. It is controlled by the "Not Go" gage, which establishes the minimum dimension and hence the maximum looseness permissible between the mating parts.

Advantages of Roll Type Thread Gages

The John-Sons "Go" and "Not Go" thread gages described in this article are the invention of Charles G. Johnson, and are manufactured by the Pratt & Whitney Co., Hartford, Conn. The gage shown in Fig. 1 is of the conventional U-shaped design used for limit snap gages. The gaging elements are annular ribbed rollers which rotate on adjustable eccentric pin bearings.

The advantages claimed for the annular ribbed and freely rotatable roll are, first, a considerable reduction in wear on the rolls due to the elimination of friction between the gage and the screw being gaged; second, freedom from the binding and cramping action encountered in thread snap gages having fixed gaging points or flat jaws; third, adjustability of the gage, which amounts to 0.040 inch in sizes 1/4 inch and larger, and to 0.016 inch in sizes between No. 0 and No. 12. This affords a means of compensating for the slight wear that may occur in the rolls after considerable use, or for changes in pitch diameter specifications. The second advantage cited—freedom from binding—makes it possible to perform the gaging operations very rapidly.

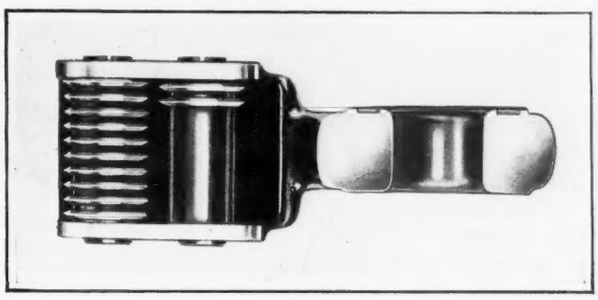


Fig. 2. Cross-sectional View of Gage Shown in Fig. 1

Requirements Insuring Interchangeability and Dependability

To determine the interchangeability and dependability of screw threads, the gage must test accurately the lead, maximum and minimum pitch diameters, thread angle and form, concentricity, and straightness. In Fig. 2 is shown a split section of the John-Sons gage designed to fulfill these requirements. The roll at the left is the "Go" roll, and the one at the right the "Not Go" roll.

The "Go" rolls have several gaging ribs which provide for checking the lead as well as the maximum pitch diameter to which these rolls are set. Further, the contour of the ribs of the "Go" rolls represents the form required to permit assembly. The "Go" rolls, therefore, check simultaneously the several elements of the screw thread, and assure that any errors which may be present are compensated for, so that there will be no interference in assembling. Hence, interchangeability is controlled by the "Go" gage.

Compensating for Thread Errors

Errors in lead and in the form and angle of a thread, must be compensated for so that difficulties in assembling will be avoided. A gage for testing the lead is shown in Fig. 3. The usual method of avoiding assembly interferences is to reduce the pitch diameter of the screw. This, in many instances, impairs the dependability of the thread. Therefore, the "Not Go" gage, which controls this factor, must be designed specifically to gage the pitch diameter of the screw.

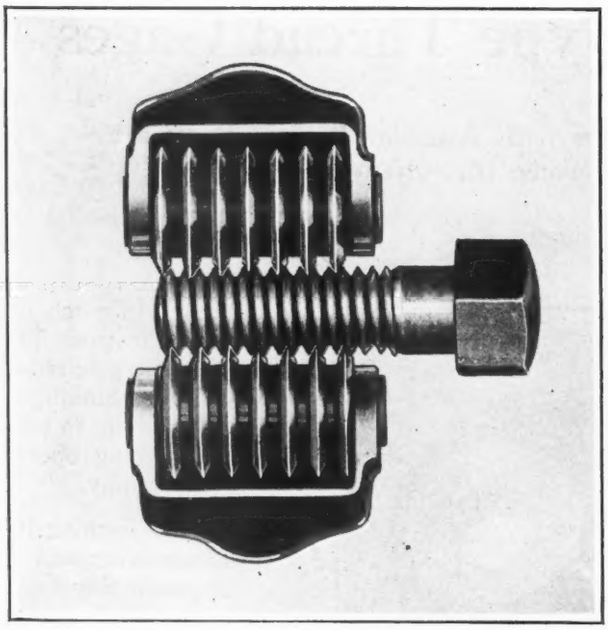


Fig. 3. Lead Error of Screw Detected by Visible Check

It will be noted that the "Not Go" element of the gage shown in Fig. 2 contains but two ribs. This permits the diametral dimension to be checked separately, without interference from errors in the lead of the thread. The profile of the "Not Go" roll is well flattened at the crest to avoid the possibility of gaging the effective pitch diameter of a screw thread erroneously as a result of contact below the pitch line. It also assures that the pitch diameter will not be reduced below the permissible minimum size due to interference resulting from form and angle errors.

Checking Threads for Roundness

Out-of-round threads, especially threads on parts having a large diameter such as shown in Fig. 4, are very common. The elliptical condition causes an excessive strain on the threads at the points of contact with the mating part. This condition cannot be detected by the ring thread gage, with its peripheral engagement. A gaging means having diametral contact, such as is afforded by caliper or snap gages, is the only method of detecting out-of-roundness.

To check for out-of-roundness with the gage shown in Fig. 4, the piece is passed between the "Go" rolls and into contact with the "Not Go" rolls. While engaged with the "Not Go" rolls, the piece is given a quarter turn. Should the screw be under size at any point, it will drop between the "Not Go" rolls. If it is not under size, it will be passed out between the "Go" rolls. Should the screw be over size, at the newly presented cross-section, it will not pass between the "Go" rolls. By this process out-of-roundness is detected.

Testing for Straightness

The straightness of a screw thread is determined by bringing both ends of the screw into contact with the "Not Go" rolls. With the ring thread gage, a tapered condition may escape detection, as a "Not Go" ring may not start on the thread, the screw being up to size on the end presented to the gage, while the other end of the thread, which cannot be brought into contact with the gage, may be under size due to a back taper.

The gages described are made in sizes ranging from 1/16 inch up. Special adapters used in conjunction with the gages considerably enhance their efficiency. For example, a simple flat base with a vise for holding the gage in a convenient position, enables the gaging to be done much more rapidly.

* * *

MEETING OF ACETYLENE ASSOCIATION

The thirty-first annual convention of the International Acetylene Association was held at Congress Hotel, Chicago, Ill., November 12 to 14. Among the papers read were: "Production Welding by the Oxy-Acetylene Process," by Earl C. Booth, engineer, Noblitt-Sparks Industries, Inc., Indianapolis, Ind.; "Experiments on Gas-welded Structural Joints," by James R. Griffith, professor of structural engineering, Oregon State Agricultural College, Corvallis, Ore.; "General Railroad Welding," by G. H. Gjertsen, master welder, Northern Pacific Railway Co., St. Paul, Minn.; and "Commercial Aircraft Welding," by Charles Froesch, general service manager, Fokker Aircraft Corporation of America, Hasbrouck Heights, N. J.

Fig. 4. Roll Type Gage and Fixture for Checking Large-diameter Shell Threads

Special Tools and Devices for Railway Shops

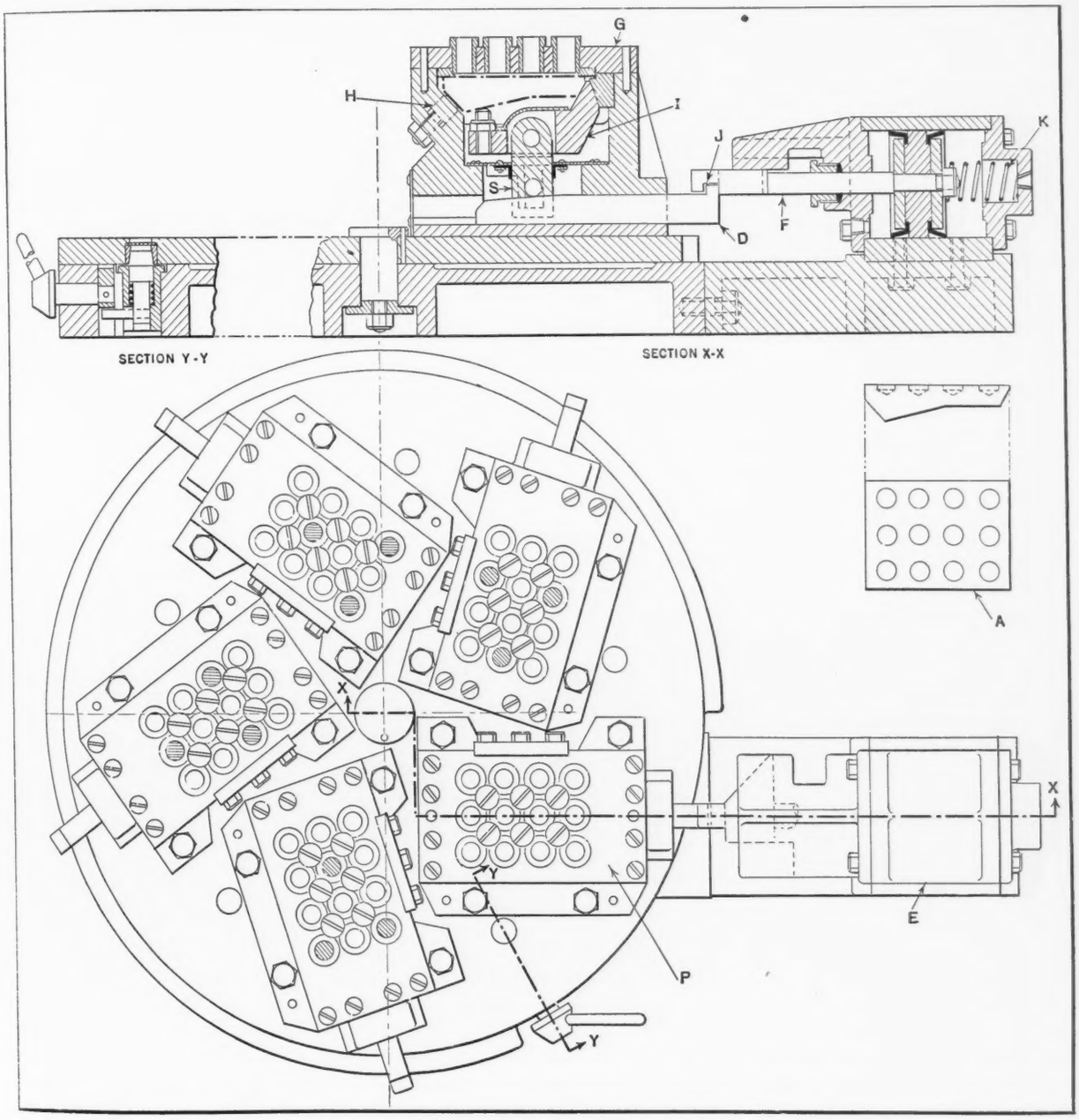
Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Devices

INDEXING JIG WITH AIR-OPERATED CLAMPING DEVICE

By WILLIAM C. LANDIS, Wilmerding, Pa.

In response to a demand for higher production in drilling side wedges for friction draft gears on railway freight cars, the equipment shown in the accompanying illustration was designed and built. In these wedges, one of which is shown at *A*, are drilled twelve 3/4-inch holes located close together.

The equipment formerly employed consisted of a simple jig, which was used in a single-spindle drill press, each hole in the wedge being drilled separately. With the new method, however, the job is done in a multiple-spindle drill press, and twelve holes are drilled simultaneously while a wedge is being loaded in another part of the jig. Hence, the only lost time is that elapsing during the indexing movements, which are accomplished manually, although the work is clamped pneumatically.



Indexing Jig in which Work is Clamped Pneumatically at Loading Station

Five separate jigs are used in the operation, and they are bolted to a circular indexing table, the indexing being done by hand. The clamping of the work is done pneumatically and controlled by a three-way hand valve. Referring to the illustration, it will be seen that jig *P* is directly opposite the air cylinder *E* and that the end of the piston-rod *F* is in engagement with a wedge *D* which serves to operate the work-tightening clamp *I* under the action of the air cylinder unit.

The action of this wedge may be more clearly understood by referring to the upper view, in which the work is indicated by heavy dot-and-dash lines. The top face of the work is forced against the plate secured to the under side of the bushing plate *G* and against the adjustable screw stop *H* by means of the angular clamp *I*. The clamp is given a vertical movement through the medium of wedge *D*, which acts against a hardened pin driven into the plunger *S*, the plunger, in turn, being pivoted to the clamp *I*.

The air cylinder is positioned on the base of the fixture so that the rotation of the table causes wedge *D* to engage the notch *J* in the piston-rod. The manner in which this engagement occurs is more clearly shown in the plan view. Here it will be seen that the end of the piston-rod is beveled so that as the wedge rotates with the indexing table, its end will ride against the bevel and thus be guided into the notch *J;* in this way, compensation is made for any variation in the position of the wedge due to the irregularities of the casting being drilled. In order to keep the piston-rod in position to engage the wedge, a spring *K* is provided which returns the piston to the left when the valve is in its neutral position.

The jigs are so located on the indexing plate that three different holes are drilled in each of the four castings. No drilling, however, is done in the jig opposite the air cylinder, as this is the loading position. It is obvious, therefore, that immediately after indexing, one jig will be in the loading position and the other four in position for drilling. This arrangement was necessary because of the close spacing of the holes in the casting. The holes indicated by cross-section lines in four of the jigs are located directly under the drills.

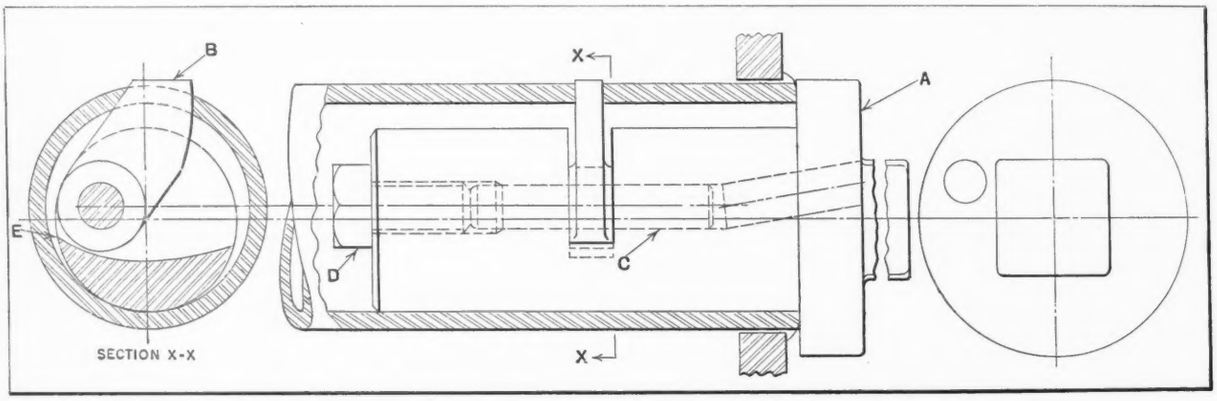
TOOL FOR REMOVING DEFECTIVE FLUES FROM BOILERS

By H. H. HENSON, Foreman, Machine and Erecting Shop, Southern Railway Co., Chattanooga, Tenn.

One of the many devices in use for removing defective flues from locomotive boilers is shown in the illustration. This tool consists chiefly of the holder *A*, which is made somewhat smaller in diameter than the bore of the flue. The center of the shank of holder *A* is slotted laterally to receive the cutter *B*. The cutter is made of high-speed steel, and pivots on pin *C*. To facilitate the removal of this pin, a hole is drilled through the shank end of the holder. The screw *D* prevents the pin from coming out of the holder.

The tool is driven by means of an air drill. In order to provide a powerful drive for the tool, a gear reduction unit is interposed between the tool and the drill. The end of the shank is squared off to fit the spindle of the unit.

In operation, the tool is inserted in the end of the flue to be removed from the boiler. When the tool is revolved, the cutter swings outward and, in doing so, is forced through the flue. As the tool continues to rotate, the cutter turns on pin *C* until its edge rests upon the bottom of the lateral slot at *E*. Continued rotary movement of the tool causes the cutter to pass around the flue, severing the latter completely. Less than one and one-half revolutions of the tool are all that is required to sever the flue. It is obvious that the small end of the flue left on the tool can be easily removed from the flue sheet, while the other end can be pushed out through the rear of the boiler.



Details of Design of Flue Cutting Tool

* * *

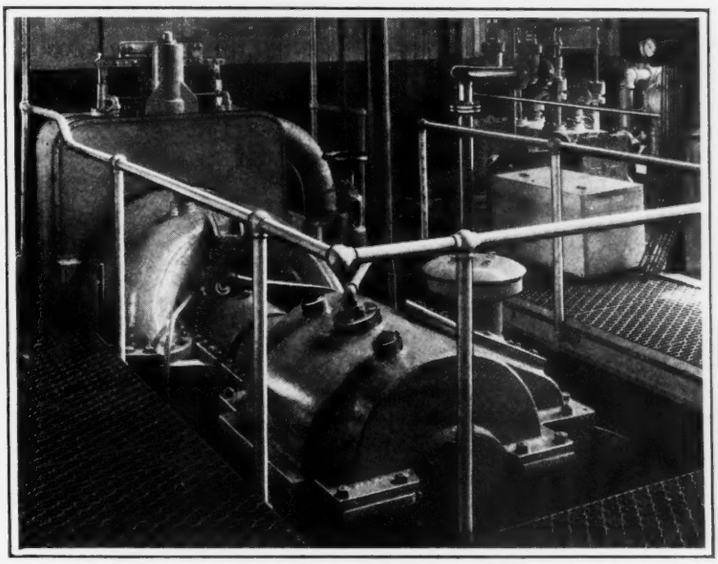
In a period of generally quiet business, it is encouraging to learn of concerns whose volume of business has been satisfactory. The Young Radiator Co., Racine, Wis., writes us that the company's sales this year have equalled the 1929 business, and that the September orders were the largest for any month up to that time during the year. Every month some new machinery has been installed in the plant, and a steadily increasing business is being looked forward to from now on.

Notes and Comment on Engineering Topics

A Bus that Can Travel Both on Railway Tracks and on the Road—Growth of the Oil Burner Industry—Small Rotors Produced by Die-casting

The ever increasing application of electric welding is well illustrated in the accompanying illustration. Here is shown an all-welded steel gear-case for a 1400-horsepower geared turbine drive, which has been installed on the American Dredging Co.'s dredge *New Jersey*, by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

A recent development which may have an important influence on the future means of transporting both passengers and freight is the introduction of a vehicle that will be capable of service both on a railway line and on highways. Karrier Motors, Ltd., Huddersfield, England, and the London, Midland & Scottish Railway Co. are cooperating in this development. The vehicle resembles an ordinary motor bus, and runs on the road in the usual way on rubber tires. It can be transferred to a railway line at any prearranged point, the road wheels being lifted from their position by an ingenious device and replaced by railway car wheels, the change occupying only thirty seconds per wheel. When the road vehicle becomes a railway car, a second gear-box comes into operation, and the engine employed on the road is able to drive it at a speed of up to 60 miles an hour on the rails. It is feasible for the bus to collect passengers in a town, carry them to a railway line, travel on the railway for fifty miles, and again take to the road with its passengers, leaving them at a destination remote from the railway.



An All-welded Steel Gear-case for a 1400-horsepower Geared Turbine Drive Made by the Westinghouse Electric & Mfg. Co.

An indication of the growth of the oil burner industry during the last ten years is furnished by statistics collected by the American Oil Burner Association, 342 Madison Ave., New York City. In 1921, only 12,500 homes in the United States were heated by oil burners. Today this number has reached 535,000. At the present rate of increase, about 120,000 homes are being equipped with oil burners annually.

A new fare receiver that makes change automatically has been developed in Norway, and a patent on this apparatus has recently been taken out. The device is similar to the fare receiver used in this country, but instead of taking only the amount of the fare, it changes the coin inserted and returns the correct amount to the passenger. It is being tried out on the street cars of Oslo.

An interesting example of the increasing use of the die-casting process is afforded by a British manufacturer of electrical equipment who is die-casting small rotors. These are made in sizes up to 10 inches in diameter by 10 inches long, and can be cast at the rate of thirty per hour. The material used is aluminum, and owing to the somewhat lower electrical conductivity of this material, as compared with copper, some modification in the shape of the iron laminations is necessary, the slots being slightly enlarged; but the advantages of pressure die-casting are so great that the work involved in changing the design is considered of secondary importance.

Primarily, the "free-wheeling" feature recently incorporated in the design of Studebaker cars is to the automobile what the coaster-brake is to the bicycle. Whenever the momentum of the car on the level or on a down grade in the road causes the car to travel at a higher speed than the operating speed of the engine, the free-wheeling feature automatically disengages the engine from the drive, so that it does not act as a brake on the car. Thus the engine is allowed to "idle" a considerable portion of the time, with a resultant saving in fuel and less wear on the transmission. This feature also provides for silent gear shifting between second and high speeds without operating the clutch. The free-wheeling feature can be made inoperative when it is desired to utilize the engine as a brake in descending long steep grades.

Current Editorial Comment

In the Machine-building and Kindred Industries

OPERATING A SHOP DURING A DEPRESSION

One of the most serious problems facing the manufacturer during a business depression is that of keeping a well-trained organization together. When men are laid off, they are likely sooner or later to find work elsewhere, and if the new job is satisfactory, they will remain with their new employer. Thus, when business resumes normal activity, many manufacturers find it necessary to build up their organizations with new men whose training may be limited and who are not familiar with their work.

Most shops try to meet the emergency by reducing the number of working hours per week, so that they can keep as many of their men as possible. During the present business depression, it has been necessary for many manufacturers to reduce operations to four, and even three, days a week.

A plan that has not been generally applied has been put into effect with satisfactory results by a well-known machine tool builder in the Middle West. Instead of reducing the working week to three days, this manufacturer has divided his force into two equal parts; half of the men work five full days one week, and the others work five days the next week. In this way, if rush jobs come in, there is an adequate force of men to take care of them, and on the whole, this plan has been found more satisfactory than that of shutting down the plant half a week right along.

The shop men are also well pleased with this arrangement. If they have to be idle half of the time, they seem to prefer to work a full week and be idle a full week, rather than to work short time every week. It is a plan that has definite advantages and may be well worth trying in shops that must reduce their output temporarily.

* * *

MARKET RESEARCH—INDUSTRY'S NEXT STEP FORWARD

The marked reduction in manufacturing costs that has been effected during recent years is due mainly to the painstaking studies that have been made of production problems and the research work carried on in the mechanical industries. Selling costs, unfortunately, have not been reduced in the same proportion; in fact, they have generally increased.

One reason for this condition is that distribution problems have not received as careful study as production problems; yet successful marketing requires as complete knowledge of the facts as manufacturing. It is possible to base a selling campaign on just as accurate and carefully collected information as is used in solving production problems. Manufacturers in every branch of industry now recognize this and are beginning to collect information and statistics that will be helpful to them in planning their sales campaigns.

As an example of the results that have been obtained through market research, the experience of one concern manufacturing an accessory used in practically all industries may be related. This manufacturer had made no particular effort to reach the machine shop industry, because his estimate of the value of this market had been based on opinions rather than on facts. A careful survey revealed the fact that the total business in equipment of the type made by this manufacturer amounted to $20,000,000 annually in the machinery and metal-working industries. Of this total, the company's share had been less than $50,000 a year. Realizing the importance of this market, greater sales effort was directed toward the machine shop field, with the result that the company's sales increased to $300,000 a year.

* * *

INCENTIVE WITHOUT BONUS

A well-known machinery manufacturer recently told us of a wage payment plan established in his plant which has all the advantages of the bonus system, although actual bonuses are not paid.

The plan is, briefly, as follows: Time studies are made of all the operations in the plant, and a standard time is established for each operation. This standard time is given on the shop orders, so that each man knows what time is allowed on the work given to him; but whether he performs the work in less than the standard time or not, no direct bonus is paid. However, a record of his performance is kept, and a man who regularly performs his work in less than the established standard time receives a raise in pay. If at some future time he begins regularly to fall below his previous high mark, his pay is reduced accordingly.

Both the shop men and the management are well pleased with this system. The former are relieved of the nervous tension that always accompanies a bonus system. It is their average performance that counts and not the bonus earned on each operation. Then, too, they are assured of the same amount in their pay envelopes each week, and a raise in pay is assured if merited. The management gains, because the clerical work necessary to figure bonus earnings for every operation is eliminated. A better feeling also seems to exist throughout the shop.

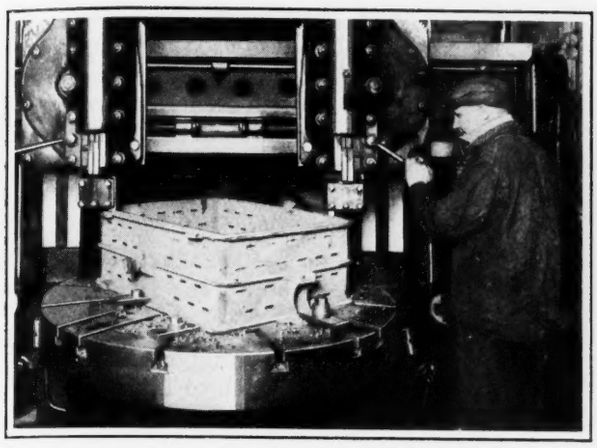


Fig. 1. Machining a Foundry Flask with Tungsten-carbide Tools at a Speed of 80 Surface Feet per Minute

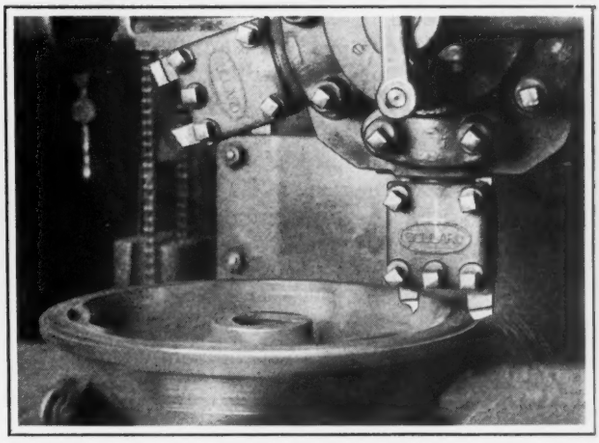


Fig. 2. Machining Cast Iron at 210 Surface Feet per Minute. Photograph Taken with Machine Running at Full Speed

Tungsten-Carbide in the Westinghouse Plant

Directions for Obtaining the Best Results with the New Tungsten-carbide Cutting Tools in Regular Machine Shop Practice

By J. M. HIGHDUCHECK
Assistant Superintendent
Manufacturing Equipment Department
Westinghouse Electric & Mfg. Co.

THE last few years have produced revolutionary trends in the machine shop industry, and we may expect to see some radically new developments within the next ten years. In these, the introduction of tungsten-carbide tools will unquestionably play an important part.

Tungsten-carbide cutting tools have been remarkably successful in many types of machining operations at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. They have been especially successful for operations on cast iron, semi-steel, and malleable iron, and for some operations on steel. The economies effected are mainly due to the fact that the machines may be speeded up or the depth of the cut increased, so that the same equipment will produce more. There are other less obvious economies resulting from the fact that it is not necessary to stop the machine to regrind tools as often as was formerly the case. The tungsten-carbide tools last longer between grindings when using higher speeds than were formerly employed, with the same feeds.

Differences in the Application of Tungsten-carbide and High-speed Steel Tools

It should not be assumed that tungsten-carbide tools can be used as a direct substitute for high-speed steel tools without some study of conditions. The successful machining of certain materials with the newer tools requires, in some instances, that changes be made in the shapes of the tools. The extent of these changes necessarily depends largely upon the character of the work and the machine tool used. Hence, it is impossible to give rules that would cover all the details of such changes; but a definite understanding of the fundamental requirements and principles involved will permit the average machinist to handle the tools successfully.

It must be remembered that the tungsten-carbide tools are brittle. The tool shank must be properly designed and the tip must be of suitable proportions. It is important that high-grade shank material be used, having great toughness and a Brinell hardness of about 300. The milling of the slots or recesses for the tip is of great importance. The bottom of the recess must be flat and no part must be lower than any other part. The tips must be fitted so that they rest flat on the seat and must be in complete contact on all supporting surfaces.

Brazing Tungsten-carbide Tipped Tools

Before brazing the tip to the shank, wash the shank and the tip in carbon tetrachloride. For brazing, sheet copper about 0.003 inch thick should be used. Trim one piece of copper to the shape of the bottom of the recess and use as many other pieces to fit the sides and radii as are required. Place the tip in the correct position and tie it to the shank with molybdenum wire. Always insert a piece of copper wire between the molybdenum wire and the tip, with one end of the copper wire turned up. This wire acts as an indicator. It tells when the copper has melted around the tip in the brazing furnace.

Use powdered borax or "Fluxine" as a flux. When the latter is used, it should be dissolved in water and the tip end of the tool dipped in this solution, after which it is left to dry for a few minutes. The tool shank is then placed in an electric furnace having a hydrogen atmosphere.

As far as information is available, it seems that

the best results in brazing tips on tools up to one square inch in cross-section can be obtained by using a furnace 3 inches in diameter with a temperature of 1175 degrees C. (2147 degrees F.). For tools having a cross-section of 2 square inches, a 5-inch diameter furnace should be used at a temperature of 1225 degrees C. (2237 degrees F.). After the tool has been held from 1/2 to 1 minute in the furnace at this heat, it should be withdrawn and placed in mica dust until cool enough to handle.

Grinding Tungsten-carbide Tipped Tools

At first the grinding of tungsten-carbide tools was done entirely "free hand" or "off-hand"; that is, the tool was held by hand against the grinding wheel with or without a work-rest. This limited the tools to a comparatively few simple shapes. Present experience, however, permits all ordinary grinding operations to be performed successfully on these tools, including form grinding.

While free-hand grinding is recommended for quick results, with a minimum danger of injury to the tool finish, accuracy of clearance angles and keenness of edge are obtained more easily by holding the tool in a vise. There are many grinding machines on the market equipped with vises that can be set to hold the tool at the required angles.

On account of the high cost of tungsten carbide, only very small amounts should be ground off. These tools can be ground successfully either wet or dry. The recommendations of the manufacturer should be followed in this respect. When only a small amount of tungsten carbide is to be removed, dry grinding is recommended as being safer. If wet grinding is employed, a continuous flow of water or cooling solution should be used.

It is good practice to diamond-lap the tools after they have been finish-ground, as a slightly chipped cutting edge is much less durable than one that is finely finished. The abrasives used for lapping are silicon carbide, boron carbide, and diamond powder, the abrasive being mixed with a carrier and spread on the lapping disk. Suitable carriers are water, kerosene, lubricating oil, and olive oil. Silicon carbide and boron carbide have proved economical for the rapid removal of tungsten carbide by lapping.

How to Obtain the Best Results from Tungsten-carbide Tools

In the application of the new cutting tools to machining processes, the Westinghouse Electric & Mfg. Co. has found it advisable to use these tools in almost all cases when machining cast iron, semi-steel, brass, Micarta bakelite, or fiber in quantity production. It is necessary to give the operator all the instructions possible. He must understand that the tools cannot be used in exactly the same manner as the tools that he has formerly used. In a large plant, there should be a separate division for handling tungsten-carbide tipped tools. This division should be responsible for the purchase, design, and application of these tools. On account of the high cost of tungsten carbide, great care must be exercised in the selection of the tools for different applications.

A sufficient number of tools for each set-up is necessary, because the operator should not have to wait while the tools are being reground. Standard tools should be used whenever possible, and the operator should be informed of the cost of these tools, so that he will consider them in the same light as micrometers or other expensive accessories.

The operator should be thoroughly impressed with the importance of changing the tool when it requires regrinding. It should not be used when dull. However, the operator should be taught how

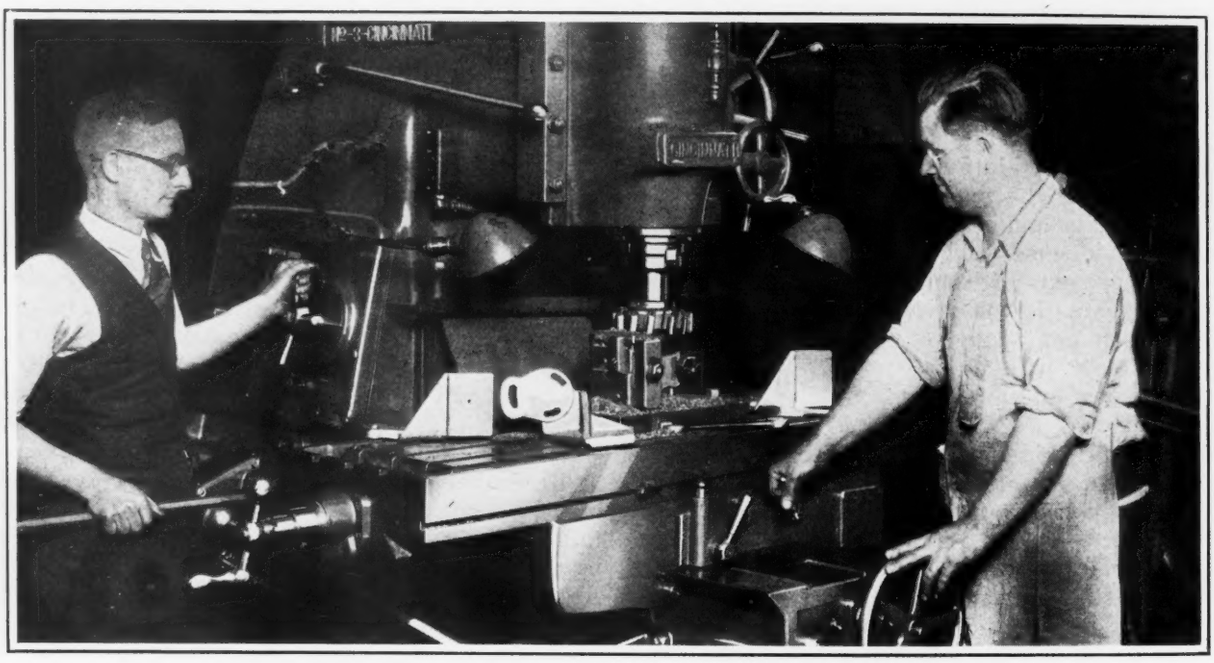


Fig. 3. Using a Milling Cutter with Tungsten-carbide Tipped Teeth

to hone the tools with a honing stone while in place, as this avoids frequent regrinding of the tools. A suitable store-room should be provided for these tools when not in use.

The overhang of the tools should not be more than one and one-half times the height. The largest tool possible of the solid shank type should be used. It is important that the operator be cautioned never to stop the machine on a cut. He must always disengage the feed before stopping. The use of too heavy a feed on castings of frail construction should be avoided, because the work will then spring away from the tool, causing both a variation in size and vibrations that are likely to ruin the tool. Tools should be designed for each specific purpose. Lathe tools should not be used in boring mills. The machine in which these tools are used should always be kept in first-class condition.

As regards the tools themselves, the following suggestions may prove of value: Use no greater clearance than is absolutely necessary. Provide supports as near to the cutting edge as possible; lack of support frequently causes chatter and unnecessary breakage. Avoid sharp corners on roughing tools.

Examples of the Application of Tungsten-carbide Tools

The accompanying illustrations show a few applications of the new cutting tools in the Westinghouse shops. Fig. 1 shows the machining of a foundry flask at 80 surface feet per minute with a 1/16-inch feed and a 3/16-inch depth of cut. With the tools formerly used, the cut was taken at 40 surface feet per minute with a 1/32-inch feed and a 3/16-inch depth of cut. Only one flask could be machined per grind with the old tools. Six flasks are machined between grinds with tungsten-carbide tools.

Fig. 2 shows the machining of cast iron at 210 surface feet per minute. The feed is 1/16 inch and the depth of cut 3/8 inch.

Fig. 3 shows a demonstrator instructing the operator in the use of a tungsten-carbide tipped milling cutter. The use of a tungsten-carbide face mill permitted an increase in the cutting speed from 110 to 180 feet per minute; the feed was increased nearly three times; the depth of cut is 1/8 inch. The number of pieces machined per grind of the cutter, which with the cutters formerly used was 75, is 220 with the tungsten-carbide cutter.

* * *

An increase of 40 per cent is reported in the shipments of service appliances and garage equipment from the United States during the first six months of 1930.

Toolmakers' Cross-hair Microscope

In an article to be published in January MACHINERY, a toolmakers' cross-hair microscope is described. This microscope provides a means of locating accurately the position of a hole to be bored that has been previously indicated on a piece of work by the intersecting point of two scribed lines. The cross-hair microscope makes it possible to locate the work quickly and accurately in position for boring, without using the well-known button method, which necessarily requires considerable time. The article gives complete information for constructing such a microscope for tool-room use.

SAVING TIME BY WELDED CONSTRUCTION

The time that may be saved by using welded designs for machine frames was cited as one of the important advantages of this method of construction in a paper presented before the recent International Congress of Steel Construction, at Liege, Belgium, by J. M. Hipple, works manager, and G. D. Fish, consulting structural engineer of the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co.

In one instance, the frame for a 5000-horsepower mill-type motor, for which the material was not in stock, was completed ready for machining in thirty days after the drawings were finished, and the complete motor was ready to ship in eighty-eight days. The time required to make the pattern for a casting is almost always more than enough to make the entire fabricated structure. In the case of smaller motor frames, where the material is carried in stock, it is only a matter of from three days to one week to produce a frame.

The reduction in weight is another advantage, resulting in greater ease of handling in manufacture, in shipping, and in erection. This reduction in weight can be made without reducing the strength. It is obvious that if a steel frame is employed that weighs as much as a casting, a much stronger structure will result.

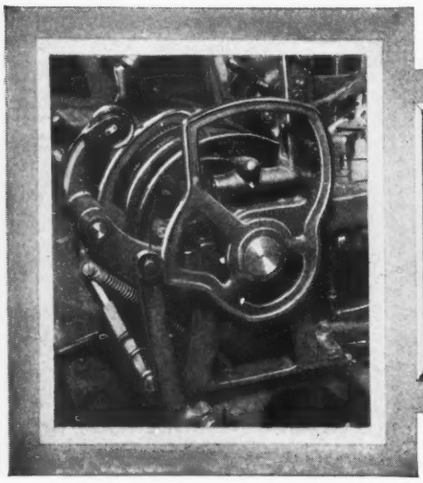
Another advantage mentioned is the uniformity of rolled material, which eliminates the danger from flaws or cracks that are sometimes present in castings as the result of shrinkage strains and are not discovered in machining. These cracks may seriously, and possibly disastrously, weaken the frame. Sometimes, when these flaws or cracks are discovered during the course of manufacture, it becomes necessary to condemn the casting, and there is a serious delay in the completion of the machine.

The amount of machining necessary can also be reduced, as compared with castings. The material is more uniform in section and it is not necessary to remove as much material. In addition, the designer can select available rolled sections in such a way as to eliminate many machining operations.

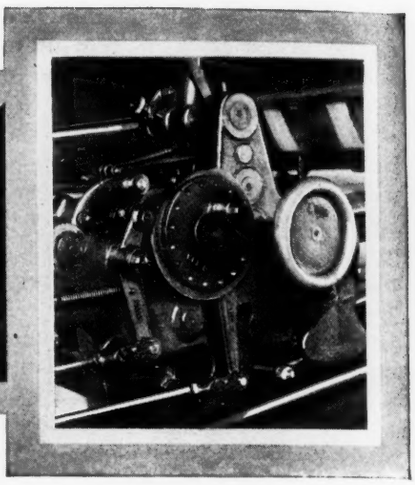
* * *

ECCENTRIC FEED MECHANISM PATENT

We are informed by the Churchill Machine Tool Co., Ltd., Broadheath, Manchester, England, that the eccentric feed mechanism illustrated and described on pages 761 and 762 of June, 1930, MACHINERY, is protected by patents owned by the Churchill Machine Tool Co., and that this mechanism cannot be applied in general machine design except through patent license arrangements.



Ingenious Mechanical Movements

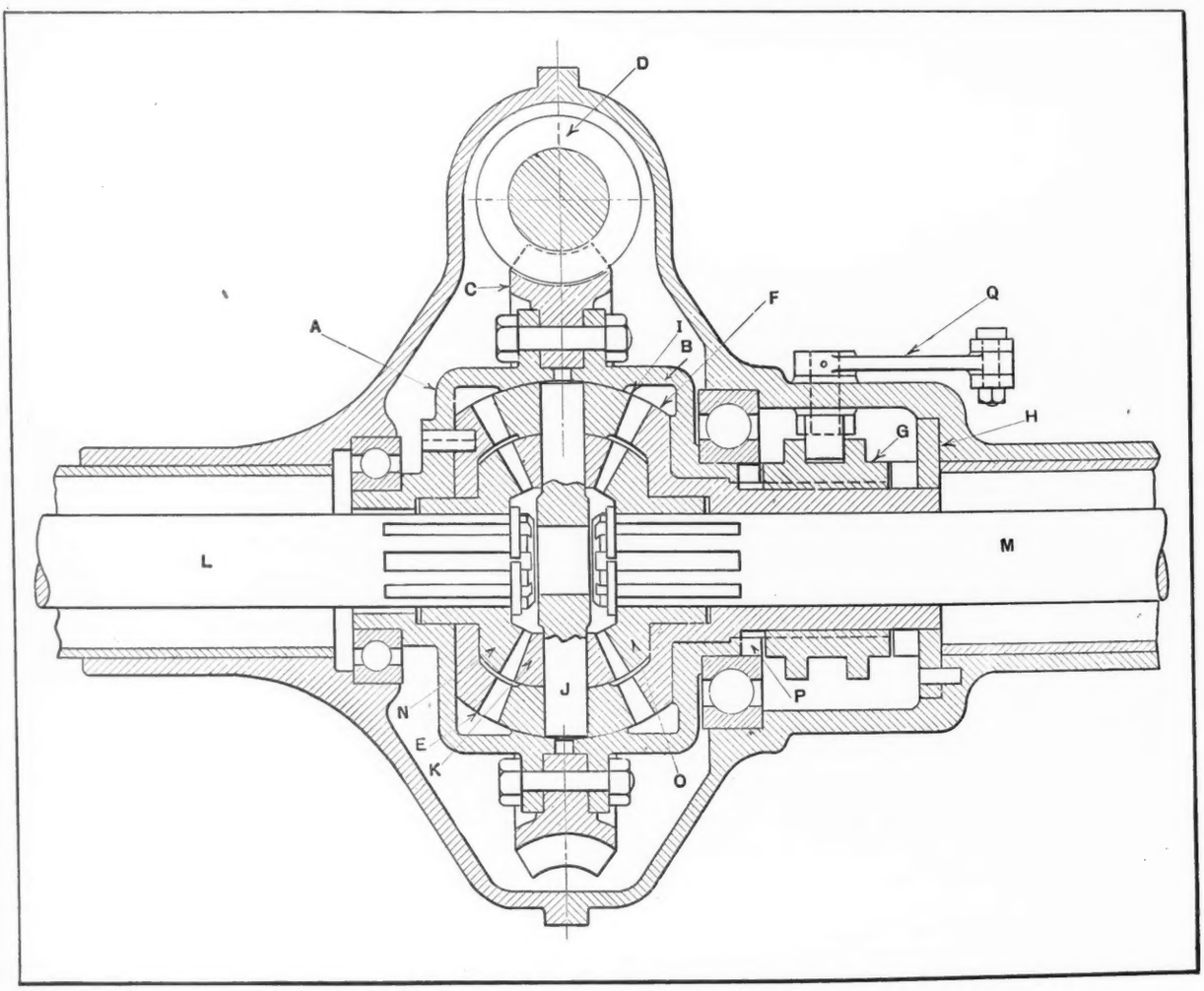


COMBINATION DIFFERENTIAL AND SPEED REDUCER

By C. F. STAPLES

Some truck and tractor differentials consist merely of an arrangement of gears to compensate for the variable speed of the rear wheels. The mechanism shown in the illustration, however, has two distinct differential motions—one for the purpose described, and the other for obtaining two speeds at a ratio of 2 to 1; thus the pulling power of the car is increased at the low speed approximately 100 per cent. Both of these movements are enclosed in one casing.

In the sectional view of the rear axle assembly, the gears are shown enclosed in the housings *A*



Automobile Differential from which Two Speeds May be Obtained

and *B*, which are mounted in ball bearings. A worm-gear *C*, clamped securely between these housings and driven from the engine by the worm *D*, serves to drive the mechanism. The bevel gear *E* is locked by a pin to the housing *A*, while the gear *F* is free to turn in housing *B* and has a projecting hub on which the clutch *G* is held by a feather key.

By sliding this clutch to the right into engagement with the stationary member *H*, the gear *F* is prevented from rotating; and when the gear *E* is rotated, the pinions *I*, which are in constant mesh with bevel gears *E* and *F*, are advanced in the same direction as gear *E*. However, as these pinions are mounted on the four-armed spider *J*, their rolling action on the gears *E* and *F* will cause the spider to revolve at one-half the speed of the gear *E*.

The movement of the spider also carries the inner pinions *K* and the gears *N* and *O* around, driving the axles *L* and *M*. It is obvious that the gears *N*, *K*, and *O* form a differential similar to that found on most cars, permitting either axle to lag. When clutch *G* is moved to the left into engagement with the jaws *P* on the casing *B*, the entire assembly is keyed together and its action is the same as in an ordinary differential case.

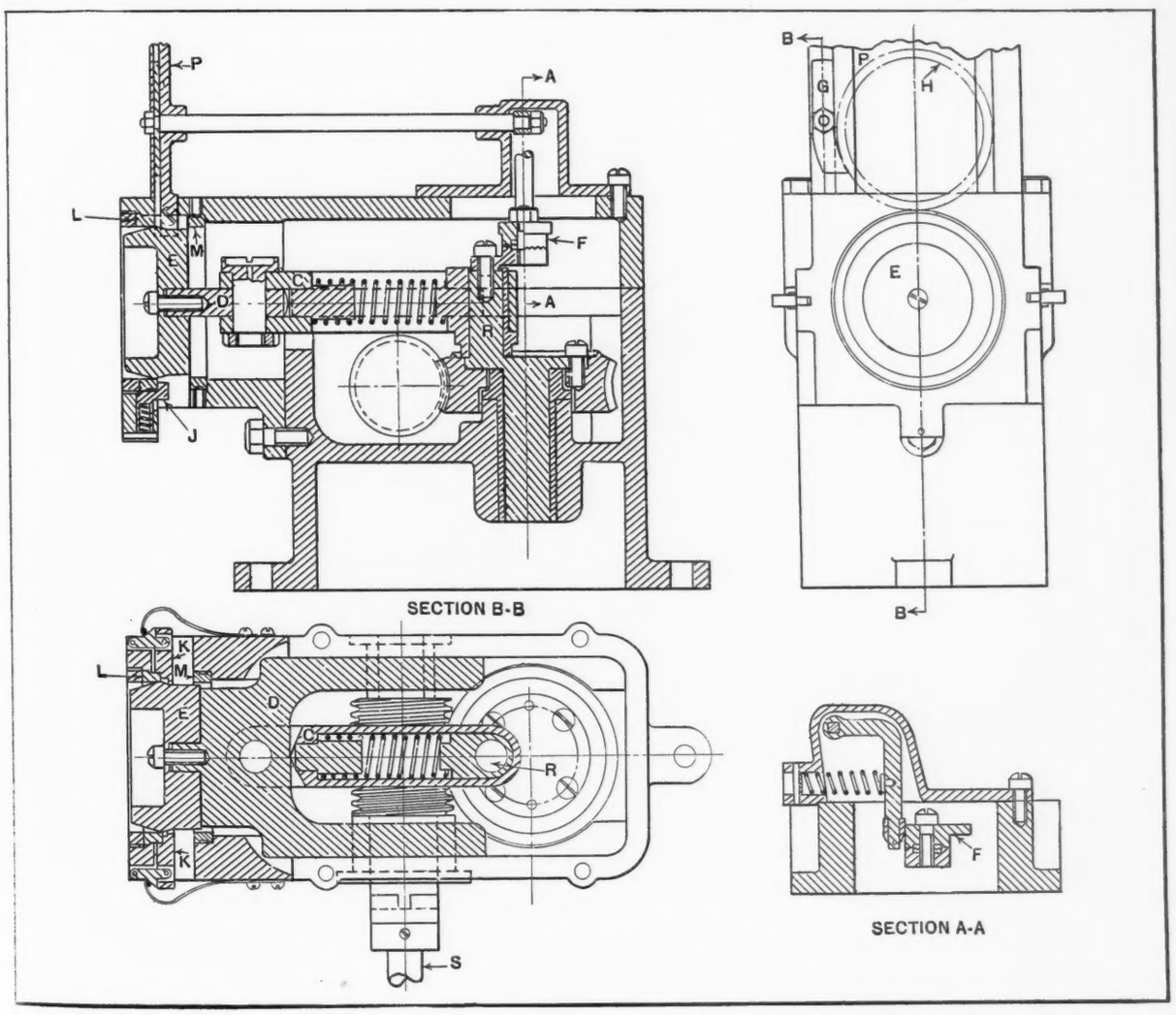
The spider *J* is free to float in the pinions *K* and *I*. The thrust of these pinions as they roll on the bevel gears is taken by the casings *A* and *B*, the spherical thrust seat being similar to that employed in a standard differential. The clutch *G* is operated by means of the lever *Q*, connected to a shifting lever near the driver's seat.

* * *

DEVICE FOR TESTING PISTON-RING EXPANSION

By WILLIAM C. LANDIS

Because of irregularities in the metal, pot-cast bronze piston packing rings for air-brake apparatus must be tested, when finished, by spreading or expanding the machined piston-ring enough to insure the springing of the ring over the piston without breaking. This test formerly was made by pulling the ring ends apart by hand, but the operation was slow and lacking in uniformity, so that many rings were broken, and defective ones passed inspection. The device to be described performs this operation uniformly and automatically by mechanical means. Gravity is utilized for inserting and ejecting the



Mechanical Device for Subjecting Piston-rings to Expansion Required in Assembling the Rings on their Pistons

rings, and one reciprocating movement of a simple cone-shaped part expands the ring and moves it from the receiving to the ejecting position.

Shaft *S*, driven by a small motor, rotates crank-pin *R* by means of a worm and wheel. Connecting-rod *C*, which links crank *R* with reciprocating slide *D*, is of collapsible, spring-buffered construction, and acts as a safety feature in case the work should clog, preventing slide *D* from moving forward. Slide *D* carries a round nose-piece *E* with conical surfaces, sloping forward and backward, over which the piston-ring *H* is forced, to test it.

Crank *R* carries an adjustable cam *F*, which is located in line with the axis of the crankshaft. This cam is timed to actuate latch *G* (see end view) through a roller lever and shaft, so that one piston-ring is allowed to drop from hopper *P* each time expander *E* is at the inner end of its stroke.

The piston-ring drops on the collapsible vertical locator *J*, between the collapsible horizontal locators *K*. These locators are made collapsible in order to allow the piston-ring to expand radially on the conical part *E* and move horizontally with it. Conical expander *E*, in its forward movement, expands the packing ring by passing through it, the piston-ring being constrained from a similar forward movement by plate *L*. As the expander reaches the forward limit of its travel (which is the position shown), the piston-ring collapses on the cylindrical part of the expander back of the double conical part. During the return movement of the expander, the piston-ring is first moved against plate *M* and then expanded over the rear cone, after which it drops by gravity into a receiving container.

The operation takes less than two seconds, which is about the time required for the operator to load the hopper. The practicability of this device is indicated by the fact that it has functioned continuously for nine years.

* * *

CLUTCHLESS REVERSING MECHANISM OF BEVEL GEAR TYPE

By P. J. McCULLOUGH

When a driven shaft requires a reversal of rotation every half revolution of the driver, the simple design of mechanism illustrated in Fig. 2 may be used to advantage for some applications. The driven pinion *C* is revolved in opposite directions by engaging alternately with half bevel gear sections *A* and *B* located on opposite sides of the pinion, so that one section begins driving soon after the other passes out of engagement. This mechanism is so arranged that the driven pinion dwells slightly prior to each reversal, and during this dwelling period it is locked in the proper position for meshing with whichever bevel gear section next comes into engagement.

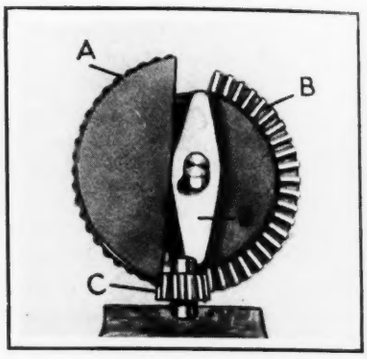


Fig. 2. Clutchless Mechanism for Reversing Rotation Every Half Revolution

The bevel gear sections *A* and *B* are fixed to a driving shaft, at the end of which is welded a cross-arm *D*. Each end of this cross-arm is formed to the shape indicated by the cross-section *E* in the diagram Fig. 1. This formed end or "stabilizer tooth" is located midway between the end teeth of the bevel gear sections, and during the dwelling period of the driven pinion *C*, one of these stabilizer teeth is passing through a slot cut across the pinion hub; consequently, the pinion is locked in the proper position for meshing with the next driving section.

The stabilizer tooth shown by the diagram Fig. 1 is in the position occupied either when entering or leaving the slot in the pinion hub. While in this position, the long side of tooth *E* prevents pinion rotation in one direction, and the end tooth of the bevel gear section prevents rotation in the opposite direction. But when this end tooth has moved out of the range of contact with the pinion teeth, the stabilizer tooth *E* will have entered the slot far enough to prevent pinion rotation in either direction; consequently, the driven pinion will be positively held in the proper meshing position for the next driving section.

This reversing mechanism has been designed for application to agitators, mixers, washing machines, and similar devices requiring a reversal of rotation at fixed periods.

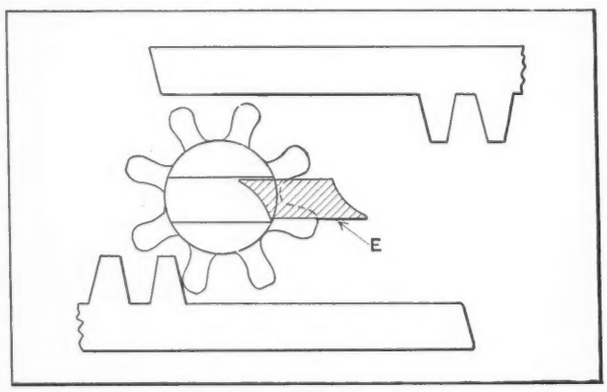


Fig. 1. Diagram Showing Positive Method of Holding Reversing Pinion During Dwell

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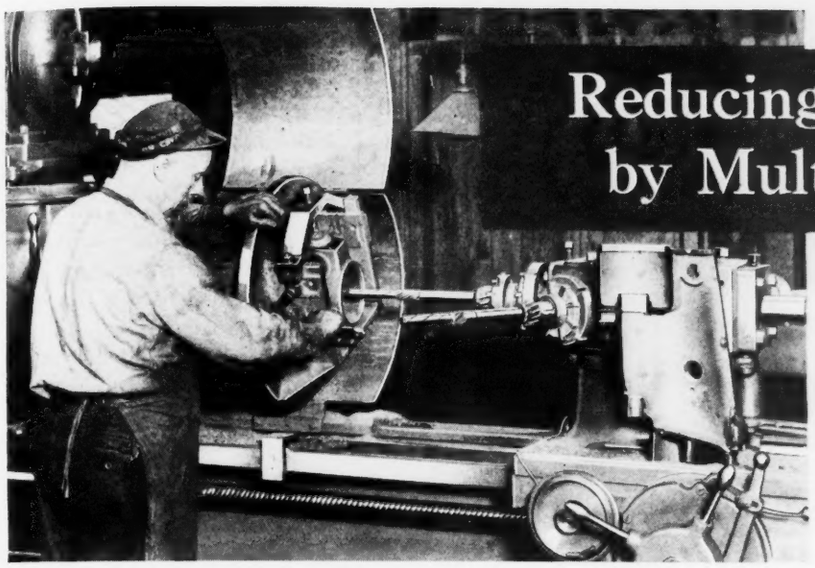
Two transformers, which for two seconds will have a capacity of over 1,500,000 horsepower, have been installed at the Schenectady Works of the General Electric Co. This maximum capacity is more than twice as great as the installation of the Niagara Falls Power Co. The transformers, which will be used with a 100,000 KVA generator, are normally rated at 33,333 KVA and are the largest yet built for testing work. They are to be used for testing switch gears of various types. Each transformer weighs about 200 tons, including 27,200 gallons of oil. The height is over 28 feet.



Reducing Operations by Multiple Tools

The Simultaneous Use of Several Tools Grouped on One Spindle Cuts Down the Number of Operations and Insures Concentricity of Circular Surfaces

ADVANTAGES obtained through the use of several tools mounted on one machine spindle were discussed in an article published in November MACHINERY, page 168. Tools used in a turret lathe and on an upright drilling machine, for machining a pump bowl and a carrier for axle drive pinions, respectively, were described in that article. The present article will deal with tools employed in operations on a cream separator frame and on a transmission case for washing machines. In the illustrations, as in the previous article, the surfaces finished will be designated by small letters, and the tools used by capital letters. All tools were designed and made by the Gairing Tool Co., Detroit, Mich.

Separator Frame Handled on a Turret Lathe

Fig. 1 shows a partial drawing of a cream separator frame. This casting is machined in a turret lathe, and is held in a box chuck mounted on the headstock spindle of the lathe, as shown in the heading illustration. The first step in the operation consists of rough-boring hole *a*, Fig. 1, with fly cutter *A*, Fig. 3; rough-boring surfaces *b* and *c* and facing surface *d*, by means of the two-step fly cutter *B*; rounding the inner corner of lip *e* with several form relief cutter blades *C*; rounding the outer corner of the same lip with blades *D*; rough-milling surface *f* with the hollow mill *E*; boring surface *g* with cutter blades *F*; facing surface *h* with blades *G*; chamfering the outer corner of rim *h* with blades *H*; and rounding the inner edge of rim *h* with tools that are not shown.

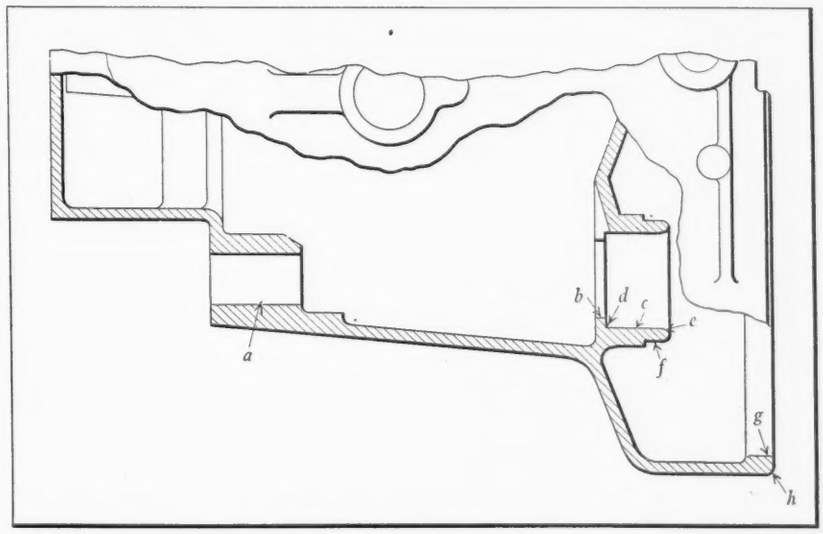


Fig. 1. Drawing Showing the Surfaces of a Cream Separator Casting that are Machined with Multiple-tool Assemblies of the Type Illustrated in Fig. 3

In this operation, the work is revolved at one speed for the cut on hole *a*, which has a finished diameter of 0.998 inch, and at a much slower speed for the remaining cuts. Bore *g* is 6 5/8 inches in diameter and, obviously, in machining this and the adjacent surfaces, the work speed, in revolutions per minute, must be reduced considerably in order that the surface speed at these points will be approximately the same as in machining the small hole.

In this operation, the tool assembly is guided by pilot *J*, Fig. 3, which enters a bushing in the box chuck that holds the work. This pilot is chromium-plated to insure long life. Fly cutters *A* and *B* are held in a secondary bar attached to the front end of the main bar *K* on which all the other tools are mounted. Adjustments are provided for advancing the cutters to compensate for wear and resharpening.

When the roughing operation just described has been completed, the turret of the machine is indexed to bring another set of tools into alignment with the work for taking the finishing cuts on the

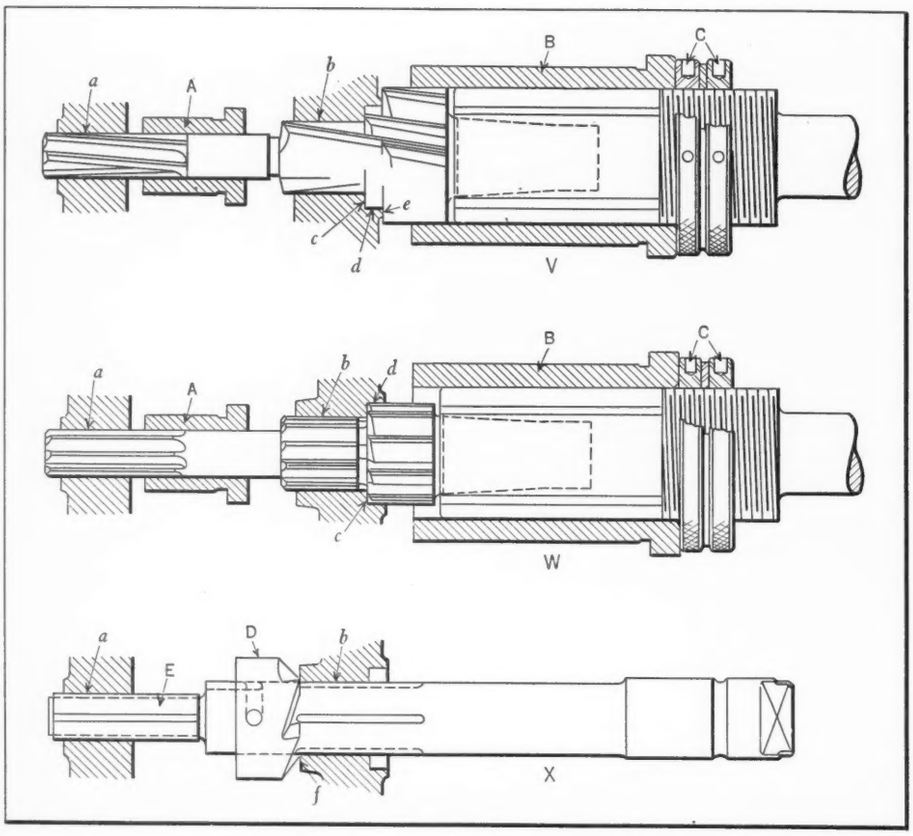


Fig. 2. Three Sets of Boring, Reaming, and Facing Tools Used Interchangeably in a Single-spindle Drilling Machine

same surfaces. This tool assembly is practically the same as that illustrated in Fig. 3, except that a two-step reamer is substituted for fly cutter *B*.

Special Multiple Tool-bars Interchanged Between Cuts

Three tool-bars used interchangeably on the spindle of an upright drilling machine for taking cuts on a washing machine transmission case are illustrated in Fig. 2. The machine spindle is equipped with a Gairing full-floating quick-change holder which enables the tools to align themselves with the bushings in the work-holding jig.

The first cuts are taken by the tool assembly shown at *V*, holes *a* and *b* being core-drilled, surface *c* faced, surface *d* bored, and surface *e* faced, all by a solid cutter which has four series of spiral cutting edges. The tools are accurately guided by pilots which engage bushings *A* and *B* in the jig. Adjustable nuts *C* control the depth of the facing cuts.

Bores *a*, *b*, and *d* are line-reamed and the bottom surface *c* faced by the solid triple-step tool of assembly *W*. This tool is also guided by pilots which register in bushings *A* and *B*, and the depth of the facing cut is controlled by nuts *C*.

After the second tool assembly has been withdrawn, the tool-bar illustrated at *X* is attached to the machine spindle. When this bar has been partly lowered into the jig and work, the combination back spot-facer and chamfering tool *D* is slipped over pilot *E* and locked in place. In doing this, the tool-bar is lowered so that pilot *E* will enter the previously reamed hole *a*. The tool-bar is next fed upward to face the surface *f* and cut a chamfer at the corner that is formed by this surface and hole *b*.

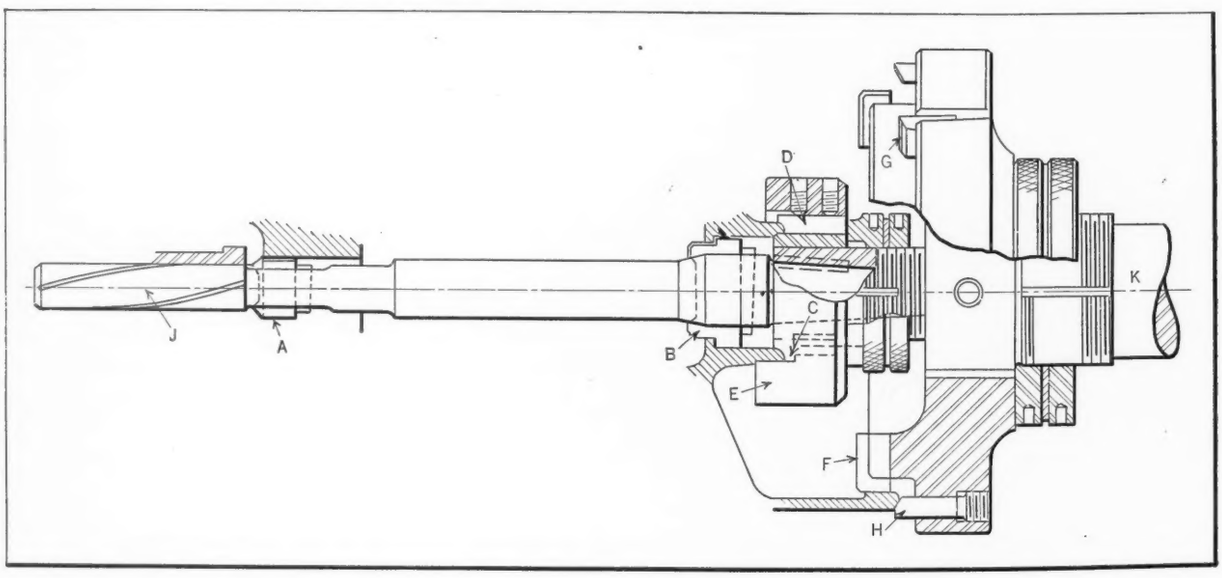


Fig. 3. Tool Assembly which Contains Eight Different Sets of Cutters for Machining a Cream Separator Casting

When the preceding operations have been completed, the work is indexed 180 degrees to bring another series of circular surfaces beneath the machine spindle. The tool assemblies illustrated in Fig. 4 are employed for machining these surfaces. Tool assembly *Y* is used for drilling the 31/64-inch hole *g*; facing surface *h*; boring hole *j*; and facing end *k*.

As the drilling of hole *g* is finished, the speed of the work is reduced considerably, so that the surface speed will be suitable for machining the remaining surfaces, which are of considerably larger diameter, bore *j* being machined in this operation to a diameter of 3.982 inches. The tools are guided by hardened wear strips inserted in the large portion of the holder, which register with bushing *F*.

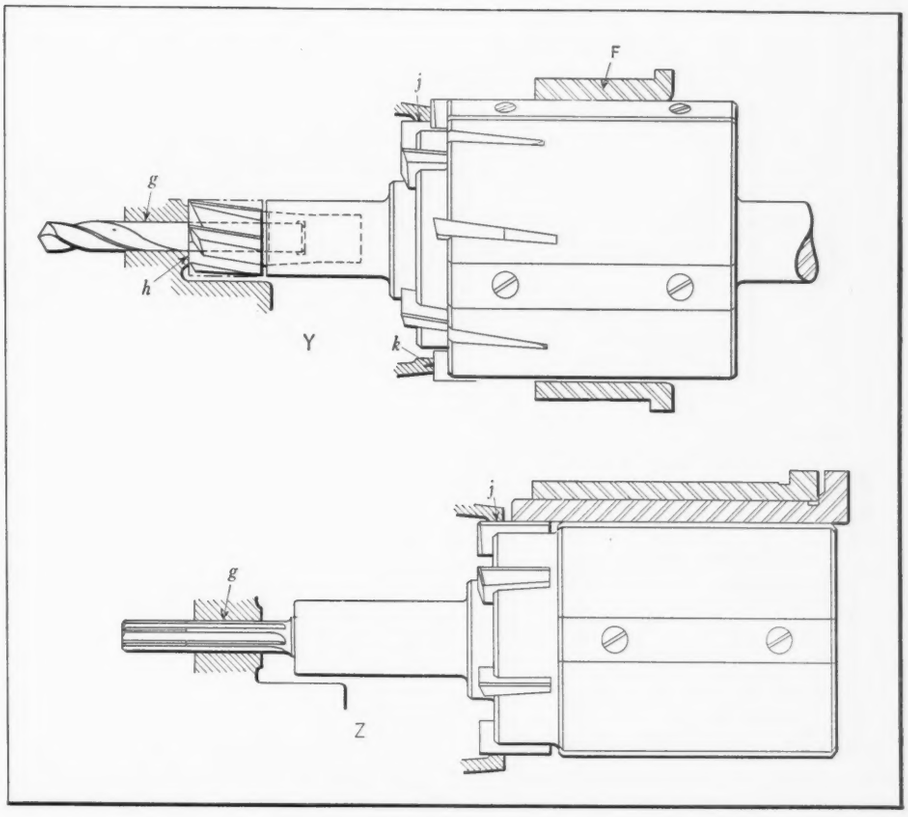


Fig. 4. Roughing and Finishing Tool Assemblies Used in Machining Surfaces that Differ Greatly in Diameter

Holes *g* and *j* are later finish-reamed by tool assembly *Z*. In addition to the guidance offered by the pilot and bushing above the cutters, the reamer for hole *g* is ground in back of the cutting edges to serve as a pilot in this hole. The inserted blades that ream hole *j* do not start cutting until the piloting surface of the smaller reamer has entered the hole. The speed of the work is reduced before the reaming of the large bore is started.

* * *

ADMIRAL TAYLOR RECEIVES JOHN FRITZ MEDAL

The John Fritz gold medal, the highest honor bestowed upon an engineer by the engineering profession in America, has been awarded for 1931 to Rear Admiral David Watson Taylor "for outstanding achievement in marine architecture, for revolutionary results in persistent research in hull design, for improvements in many types of warships, and for distinguished service as chief constructor of the United States Navy during the World War." The award was made unanimously by the John Fritz Medal Board of Award, composed of four representatives each of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers. Recent recipients of the medal include Herbert Hoover, Elmer A. Sperry, John F. Stevens, and Ambrose Swasey, the latter being the founder of the Engineering Foundation.

SAFE OPERATION OF POWER PRESSES

In a paper read before the nineteenth annual Safety Congress in Pittsburgh, Pa., George Miller, supervisor of tools in the metal-stamping department of the Westinghouse Electric & Mfg. Co., listed the dangers peculiar to power press operation. He mentioned eighteen specific dangers as follows:

1. Riding of the trip-treadle with the foot. 2. Repeating clutches. 3. Operation of presses that require repairs. 4. Operation of presses on which the safety device needs repairs. 5. The "blocking" of safety devices by the operator to increase production. 6. The use of clamp screws with worn heads and ill-fitting open-end or socket wrenches. 7. Handling thin metal sheets, scrap, or remnants without hand leathers or forks. 8. Feeding "lay-in" bender operations without the use of pliers. 9. The use of gloves on "lay-in" operations. 10. Neglecting the use of goggles where there is a possibility of flying particles. 11. Greasy dies. 12. Loose nuts and bolts of all kinds. 13. Flowing neckties and wrist-length sleeves. 14. Neglecting the use of lifting eyes on crane-handled dies. 15. Careless and indifferent stacking of finished work, such as large circles, segments, and rings from thin material. 16. Careless and improper placing of materials and tote pans about presses. 17. Failure to clear the press bed and die from wrenches, clamps, bolts, and similar parts before starting the press. 18. The habit of "parking" dies on the floor instead of on the bench.

Curved Forms or Shapes of Worm Threads

An Explanation of the Practical Advantages of the Curved Forms of Worm Threads that are Now Generally Used for Truck and Bus Drives

IN October MACHINERY, page 128, J. H. W. asks: "What are the practical advantages of the curved forms of worm threads used quite generally for truck and bus drives?" In answering this question, it may be well first to review, briefly, the ordinary form of worm thread.

The most common thread form (except in modern worm-gearing used for truck drives or other applications requiring efficient power transmission) has the straight thread shape; that is, the thread in an axial plane has straight sides, and, in many cases, each side inclines 14 1/2 degrees, so that the included angle between sides is 29 degrees. Both the inclination and depth of this thread is the same as the unmodified involute rack for spur gears of 14 1/2-degree pressure angle. A worm having this 29-degree thread may be either single- or double-threaded. Many worms have triple, quadruple, and some higher numbers of threads, but when several threads are used, it is essential to increase the thread angle or pressure angle to avoid excessive under-cutting and consequent weakening of the worm-wheel teeth.

For example, if a 29-degree thread were used for a quadruple-threaded worm, the corresponding hob used for making the worm-wheel would under-cut the teeth of this wheel excessively, thus weakening them. This explains why an included worm thread angle of 60 degrees is used for many worm-gears employed for transmitting power. The American Gear Manufacturers' Association recommends the 29-degree thread (14 1/2-degree pressure angle) for single- and double-thread worms, and a 40-degree thread for triple- and quadruple-thread worms.

It will be understood that the multiple-thread worms have much larger helix or lead angles than a single-thread worm of the same diameter and pitch, and if the thread angle or axial pressure angle is not increased for the higher helix or lead angles there will be a loss of effective tooth area. In some cases, the worm and wheel could not be assembled in the usual way, even though the wheel had been generated by a hob of exactly the same form as the worm; thus, assuming that the hob is fed tangentially to the wheel (which is the best method of hobbing a worm-wheel), it might also be necessary to screw the worm into position tangentially.

The interference which, in this instance, would prevent dropping the worm into position radially is due to the fact that on sections displaced from the worm axis, the worm thread inclination changes and a point may be reached where the side of the thread is vertical, with a reversal of the shape beyond this section; hence there is interference in assembling, unless excessive backlash is provided.

Some worm threads have straight sides in a plane normal to or square across the thread instead of straight sides in the axial plane, such as would be obtained when worm threading is done in a lathe, by using a tool, the top surface of which lies in the axial plane. A worm thread that is straight in the normal plane is not superior to one that is straight in the plane of the axis, and neither of these forms gives the best results for power transmission.

It is evident that the worms used in truck and bus drives must be capable of transmitting considerable power efficiently to insure the necessary degree of durability. Most of the worms used for this exacting service have curved instead of straight sides in the plane of the axis. The result of this change of thread form is to produce a different relation between the contacting lines or surfaces of the worm and wheel and the sliding motion. How these changes increase the load-sustaining capacity of the oil film and, consequently, the efficiency, load-carrying capacity, and durability of the gearing, will be considered briefly.

Contact between Worm and Wheel

The relation between the positions or locations of the contacting lines of the worm-wheel and the direction in which the sliding movement occurs is a very important factor in worm-gear design, because it has a decided effect on the efficiency and durability. (Theoretically, a line contact is obtained, but actually, these lines are narrow surfaces due to the elasticity of all metals, especially when heavy pressures are concentrated upon what would be line contacts if no pressure were exerted. The term contact lines, however, will be used.)

When worm-gearing is in operation, there is considerable sliding action due chiefly to the rotation of the worm. If the sliding action between the worm and worm-gear teeth is along, or parallel to, the contact lines, it will be much more difficult to maintain an oil film, especially under heavy pressures, than when the sliding motion is perpendicular to these lines or at least approaches this condition. When the sliding movement is perpendicular to a contact line or in that general direction, this tends to form a wedge-shaped oil film and to automatically build up a higher film pressure which, consequently, has much greater load-sustaining capacity than when the sliding movement is along the lines of contact.

To explain somewhat differently, if the worm thread comes into contact with the worm-gear tooth along a line that is across the sliding action, and if it remains in this crosswise position as it moves

along from one side of the tooth to the other, the oil between the two surfaces is pushed ahead and a wedging tendency occurs, the action being similar in principle to that of the Kingsbury thrust bearing. If this action is duplicated by successive contact lines as the worm and worm-gear rotate together, the ideal condition as regards maintenance of lubrication is obtained.

On the other hand, suppose the sliding action is parallel to the lines of contact or in that general direction; then there is no tendency to build up a wedge-shaped oil film and either seizure and complete failure occur or else the load capacity, efficiency, and durability of the worm-gearing are reduced considerably, as shown by many service tests of worm-gearing of the two types referred to. Thus, the importance of this matter of relation between tooth contact and direction of sliding motion has been demonstrated by the wide and successful application of the curved tooth worm in truck and bus drives, and for other purposes requiring gearing that must withstand heavy duty frequently for long continuous periods.

Contact Obtained with Ordinary Worm Thread

The ordinary worm thread of the kind widely used for miscellaneous applications has straight sides in the plane of the axis, as previously mentioned, and the worm-gear teeth in the plane of the mid-section have involute curvature, assuming that they are generated from a hob corresponding to the straight-sided worm. Now it has been demonstrated mathematically and by noting the actual contact lines on such worm-gear teeth, that these lines, while not parallel to the motion of the sliding surfaces, are near enough to that position to interfere decidedly with the maintenance of a proper oil film.

As pointed out by Earle Buckingham, associate professor of standardization of measurement, Massachusetts Institute of Technology, in a paper on "Worm-wheel Contact" presented before the American Society of Mechanical Engineers, a worm drive is practically a thrust bearing complicated by the helicoidal surface of the worm and having line contact instead of surface contact, thus introducing very high pressures and stresses between the contacting lines or minute surfaces. Since the loss of power in inefficient worm drives is caused by friction, which is reduced by lubrication, it seems logical to consider the problem as one of lubrication.

How Lubrication is Affected by the Contact between Worm and Wheel

In the paper referred to, Professor Buckingham says: "The first step toward this end is to determine the nature of the contact between the worm and worm-wheel as it affects lubrication. Most of the sliding action in worm-gearing is caused by rotation of the worm. This sliding is so much in excess of the sliding caused by the conjugate action on the tooth profiles that it would seem as though this conjugate action could be safely neglected for the present at least. As regards lubrication, the ideal contact conditions would be to have the contact lines between the worm and worm-wheel as radial lines on the worm. This would result in a condition similar to that on a Kingsbury bearing, where a wedge of lubricant is carried along just ahead of the contact line, and this contact line would extend across the worm tooth or thread from top to bottom, thus insuring practically uniform wear over the entire tooth profile.

"The poorest contact conditions as regards lubrication would be to have contact lines as arcs or circles concentric with the worm. Here the lubricant would have but little chance of being renewed as the contact progressed from the top to the bottom of the worm tooth. In addition, the worm tooth would be subject to local wear and thus tend to lose its form."

Changing the Relation between Contact Lines and Direction of Sliding Surface of Worm

The relation between the contact lines and the direction of the sliding surface of the worm can be changed by altering the shape of the worm thread. This is the most important and fundamental feature of the worm-gearing now used so widely here and abroad in the rear axle transmission of trucks and buses, and for certain other applications requiring an efficient, durable transmission. The worm of this modern gearing has threads that are curved in the axial plane, and the tendency of the wheel tooth curvature is toward the concave rather than the convex. The worm threads, however, have straight lines, but in a plane tangent to a cylinder that is approximately equal to the root diameter of the worm, instead of in a plane intersecting the axis. Different thread contours are employed to get the best relationship between the lines of contact and the direction of the sliding action, so as to favor the maintenance of an adequate lubricating oil film.

* * *

SHAPE OF WORM THREADS

By T. R. RIDEOUT, Pittsburgh, Pa.

In the October number of MACHINERY, a question was asked regarding the practical advantages of curved forms for worm threads. The reason that worms are furnished with the curved form is not primarily because of the practical advantages of this form, but because the curved form is the most economical and practical of all forms to produce.

There is a prevalent opinion that all worm threads have straight-sided forms. That opinion is a hangover from the time when the only method of producing worms was by the use of a lathe and a threading tool. With this method, it was, of course, simplest to make the thread tool with straight sides. The advent of the thread milling machine with its rotary milling cutter has rendered the chasing of worm threads with a lathe tool nearly obsolete.

The rotary thread milling cutter is made with straight cutting edges, the included angle of which

is twice the pressure angle. Those straight cutting edges produce a curved form of thread, however, owing to the fact that the cutter lies in a straight path, though inclined to the helix angle of the worm thread, whereas the thread helix has a double curvature. The greater the helix angle, the greater will be the amount of curvature of the thread form.

If we had a worm with a straight-sided form in the normal section, the axial section would be a curved form. From that fact it can readily be seen that having a curved form on the normal section, produced by a rotary milling cutter, the curvature on the axial section would be even more pronounced. As the worm has a curved form, it follows that the hob must also have a similar shape, in order that correct action be assured.

The curved form produced by a rotary milling cutter is a close approximation to the involute helicoidal curve, which has been shown to be more favorable from the standpoint of the lubrication of worm-gearing than a straight-sided form. In other words, the lubricant has more of a tendency to be forced between the thread of the worm and the tooth of the mating gear. [This is explained in the preceding article.—EDITOR] This fact is more or less incidental, for the practicability of the milling process, as previously mentioned, is the real reason for the curved form.

Standard Fits Between Cylindrical Parts

By JOHN GAILLARD, Mechanical Engineer, American Standards Association

The American Tentative Standard "Tolerances, Allowances, and Gages for Metal Fits," which was adopted in 1925, has not been utilized in manufacturing practice to the extent that the importance of a unified system would seem to warrant. This standard is to be reviewed under the procedure of the American Standards Association by a reorganized committee in order to determine whether it should be revised and supplemented. Criticisms of the existing system concern two points mainly. One of these is the problem of using reamers in the present commercial sizes; the other pertains to the absence in the standard of a series of fits arranged in accordance with the "basic shaft" system.

The objection to the American Standard concerning commercial reamer application is that the reamer diameters are reduced too quickly below the basic-hole diameters. The remedy would be to increase reamer diameters so that a new reamer would cut a standard hole having its maximum permissible size. Another proposal, entirely opposite in character, is to maintain present commercial reamer sizes and adapt the standard hole tolerances to them. This change, however, is opposed to the fundamental plan of the present American Standard, which specifies holes with unilateral plus tolerances extending from the nominal size as the reference or zero line. This basic principle has been standardized not only in the United States, but also in eleven foreign countries. A change in the American Standard would therefore also decrease the chance of getting international uniformity in practice.

In some lines of manufacture, the basic-shaft system is preferred, and it may be required, as, for example, where external parts must fit tightly on cold-drawn shafts or bars that are used without machining. The manufacturing tolerances on cold-drawn material are below the nominal size, so that the closest fit obtainable with the present American Standard is a "metal-to-metal" contact, such as occurs between a basic hole, or minimum size, and a shaft of nominal or maximum size. The only way to obtain a tight fit is to make the hole diameter less than the basic size. Cold-drawn material is generally used by manufacturers of power transmission equipment, and in many other branches of the machine-building industry.

In view of the foregoing, it would seem advisable to include the basic-shaft system with the basic-hole system. In fact, all existing national standards, except the American and British, do comprise both systems, so that manufacturers can apply whichever system meets their own requirements. In Germany, where the national standard has been adopted widely, 80 per cent of the standard gages made by a prominent manufacturer apply to the basic-hole system and 20 per cent to the basic-shaft system. Figures representing conditions in the United States are not known.

* * *

AIDING THE MECHANICAL-MINDED BOY

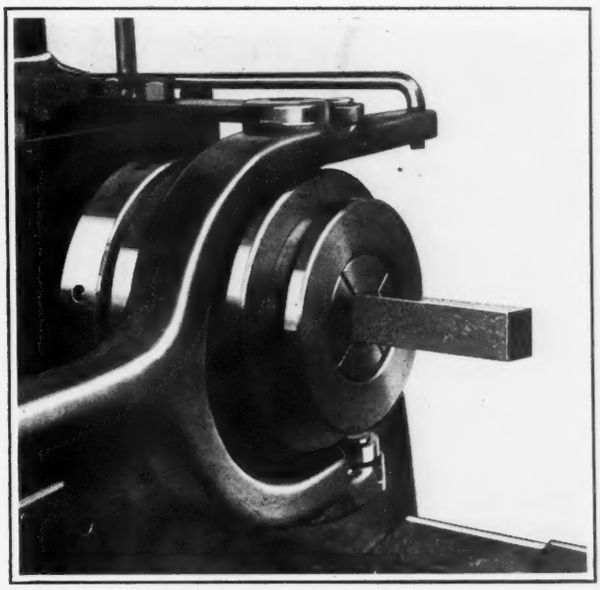
Instructors in machine shop and mechanical drawing courses have an exceptional opportunity to help guide the right types of young men into the right channels of industry. Out of a large group of students taking shop courses, only a few give evidence of real ability to make mechanical work their life's calling. Comparatively few show the inherent abilities that make for good mechanics or draftsmen.

Frequently such boys are not the most brilliant in their academic studies, although they display great talent in mechanical work. Boys of this type should be encouraged, so that they will not be lost to the engineering field. If their interest in their academic studies lags, they should not be neglected and discouraged, but, on the contrary, encouraged to develop their outstanding abilities. No effort should be spared in trying to keep them in school long enough to prepare them to take their places in shops where their ability will mark them for promotion and success. JOHN HOMEWOOD

Tool Equipment for Machining Chuck Jaws

Tools and Fixtures for Turning, Boring, and Milling Operations on Jaws for Automatic Chucks

By H. T. LAFFIN



IN the average shop, there are many jobs that are not spectacular, from the standpoint of production, but that are interesting to a mechanical man because of the methods employed. Ways and means must be devised for economical production even when the quantities are comparatively small. Sometimes the problems that have to be solved are just as difficult as those that are involved in high-production jobs.

The present article describes the methods employed in manufacturing the jaws of an automatic chuck used on the Jones & Lamson bar stock type machine. The making of these jaws furnishes an example of carefully thought out methods for accurate work done in comparatively small quantities. One of the chucks in which the jaws are used is shown in the heading illustration.

The collet jaws or pads are machined from bar stock, the blank for one set of jaws being machined in one set-up on a flat turret lathe equipped as shown in Fig. 1. This illustration shows the complete set-up with the finished piece in the chuck ready to be cut off. Jaws or pads used for round stock of large size are finished on the inside and outside to the required diameters in this set-up. The drilling operation is omitted on jaws for small sized stock or square bars. This allows the jaws to be milled to the proper size as determined by the size of square stock to be held. The sequence of operations performed with this turret lathe set-up is as follows:

First position: Run out stock and drill.

Second position: Rough-bore and rough-turn both diameters.

Third position: Rough-form tapers, using a balanced cutting tool.

Fourth position: Form the head end, finish-form the tapers, and chamfer the bore.

Fifth position: Finish-bore.

Sixth position: Cut off part.

These operations are required in making jaws for holding round stock of a size larger than 3 1/8 inches. For jaws 3 1/8 inches or smaller, the operations are the same, except that the drilling and finish-boring are omitted. In this case, the pads are milled to size as shown in Fig. 3.

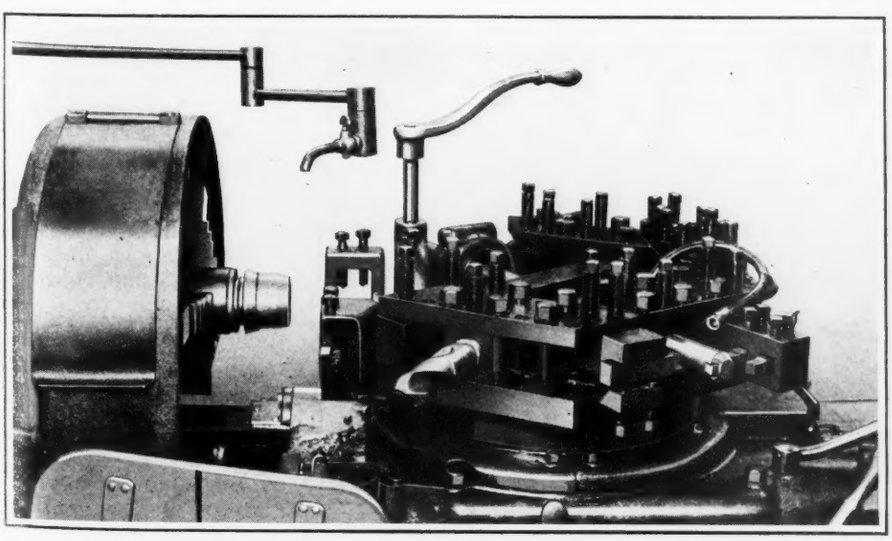


Fig. 1. Turret Lathe Set-up for Machining Chuck Jaw Blanks

The sawing operation which separates the machine blanks into four jaws or pads is performed on a hand milling machine, as illustrated in Fig. 2. The four-position indexing fixture is used for cutting the jaw into four equal parts. Following this operation, and after the burrs have been removed, the pads are placed in the fixture shown in Fig. 3. Locating surfaces in this fixture make contact with the end and two tap-

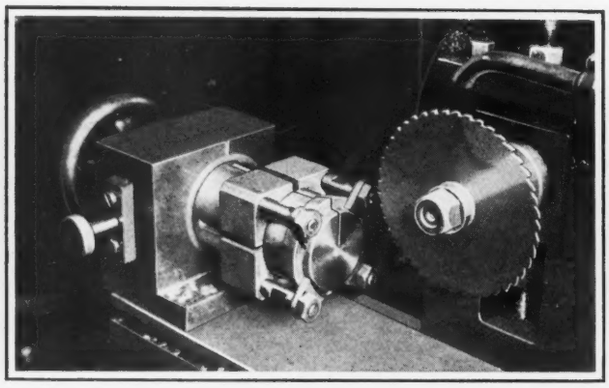


Fig. 2. Indexing Fixture Used for Cutting Blank into Four Jaws

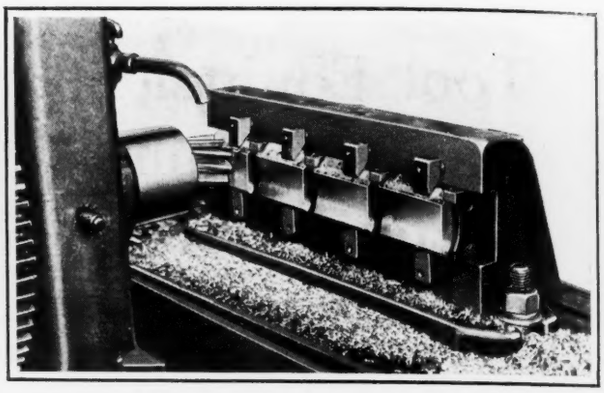


Fig. 3. Milling the Work-holding Surfaces of the Chuck Jaws

ered surfaces on the outside of the pad, so that all pads are of uniform thickness when the milling operations are completed. The end of each jaw is stamped with the size chuck in which it is to be used, and after the final burring operation, the jaws are inspected and delivered to the storeroom.

* * *

KEEPING DOWN TOOL LOSSES BY A CONTROL REGISTER

The plant of the Ohmer Fare Register Co., Dayton, Ohio, invests annually hundreds of thousands of dollars in tools for use in the manufacture of the various recording devices made by the company. At present, over one hundred toolmakers are employed in the manufacture of tools used in the company's plant. The tool cribs contain over 50,000 jigs, fixtures, and tools of all descriptions.

In order to reduce tool losses to a minimum, a mechanical system of tool control has been installed which has proved very satisfactory. One of the registers made by the company as a regular commercial product has been applied to the tool cribs as a means for controlling the inventory of tools. The records kept prove that in this way tool losses may be reduced to a minimum. Furthermore, it has been found possible to reduce the tool investment and to keep a perpetual tool inventory with a minimum amount of detail work. The new system also eliminates the use of the brass check system.

The device used, known as a tool control register, mechanically prints and issues two copies of every tool order. The following information is given on these copies: The date when the tool was issued to the workman; the tool number; the employe's check number; the type of tool issued; the transaction number (which is the consecutive number of the tool order); the register number, which immediately identifies the tool crib from which the order was issued.

An Ohmer Tool Control Register Installed in a Tool Crib for Recording Tools Issued to the Shop

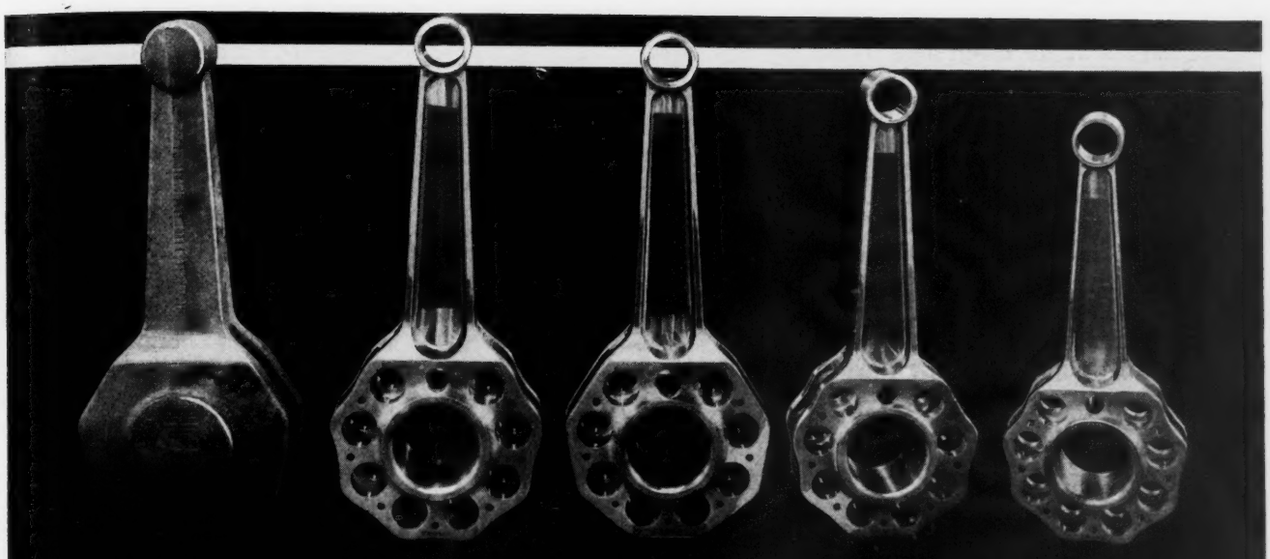
One copy of the tool order is handed to the workman, who signs for the tool issued to him. This is filed under the employe's check number and returned to him when he returns the tool. The other copy of the tool order is filed in the tool card file according to the tool number. The signing of one copy by the employe prevents misunderstandings between the tool crib man and the workman.

The information given on the two copies of the tool order is also printed on the permanent, locked-in record of the register. This record is filed for future reference and is of value in tracing tools. The transaction number on this detail record gives at once the number of tools issued to the shop during any period of time.

The workmen know that any tools charged against them and not turned in will be charged against their pay check. This makes the tool loss very low. The mechanical printed records furnished by the tool control register reduce arguments to a minimum and effect a considerable saving of time in tracing tools. The system has been installed in the Ohmer Fare Register Co.'s plant only a short time, but has already paid for itself in reduced tool investment and low tool losses. There is also a saving in the time of handling tools.

* * *

During the first six months of 1930, Germany exported 56,149 metric tons of metal-working machinery valued at approximately $24,000,000. The exports during the period mentioned exceeded in value by approximately 19 per cent the exports for the corresponding period in 1929.



Machining Master Rods for Aircraft Engines

Second of a Series of Articles on the Methods Employed in Machining Master Rods for Wasp and Hornet Engines

By FREEMAN C. DUSTON

THE method of assembling one-piece master rods on the crankpins of Wasp and Hornet engines was described in September MACHINERY. The present article describes the procedure followed by the Pratt & Whitney Aircraft Co., Hartford, Conn., in producing the master rods. These rods are made in four sizes, as shown in the heading illustration. The view to the extreme left shows a forging for the master rod of a Hornet 575-horsepower engine, which is the largest single-row radial air-cooled engine built. To the right of the forging is shown the finished rod. The third view from the left shows a finished master connecting-rod of a Hornet 525-horsepower engine.

The fourth view from the left shows the master rod of the Series C 420-horsepower Wasp engine. This is the latest development of the well-known 420-horsepower Wasp engine which holds many world's records for endurance, speed, and altitude, including the new record established by Lieutenant Apollo Soucek on June 4, 1930, when he piloted an Apache plane to an altitude of 43,166 feet, or a little over eight miles, the highest altitude ever reached by man.

At the extreme right in the heading illustration is shown a finished master rod for the Wasp Junior 300-horsepower engine, the latest addition to the Wasp and Hornet line. Although the master connecting-rods shown vary considerably in size, they are all of the same general form and are machined in a similar manner. However, the procedure described in this article applies particularly to the master connecting-rod for the 420-horsepower Series C Wasp engine. The rough-forging for this rod weighs 42 pounds and the finished rod 9.6 pounds plus or minus 0.03 pound. The finished rod is polished all over to remove scratches or tool marks.

The steel from which the forging is made must have the following chemical analysis: Carbon, 0.35 to 0.45; manganese, 0.60 to 0.80; phosphorus, 0.04 maximum; sulphur, 0.04 maximum; nickel, 1.25 to 1.75; chromium, 0.70 to 0.90. This steel is heat-treated to meet the following minimum requirements: Elastic limit, 115,000 pounds per square inch; elongation, 17 per cent; Brinell hardness, 286 to 302; contraction, 50 per cent.

First Machining Operations on Rough Forging

The first machining operation on the rough forging consists of milling the 1-inch slot shown at *A*, Fig. 1, with a 1- by 6-inch side mill. The second operation consists of milling the flat surfaces *B* with an end-mill. These finished surfaces are used in locating the work for rough-drilling the main bearing hole to a diameter of 2 1/2 inches on a single-spindle drill press.

The fourth operation is performed on a specially equipped automatic, using an 18-inch air chuck to hold the work. In this set-up, the crankpin hole is drilled to a diameter of 2 7/8 inches, while the side of the flange and the hub of the big end of the rod are rough-faced with a cutter in the forward cross-slide. The turret is then indexed and the main bearing hole bored to a diameter of 2.910 inches.

A recess 3/16 inch wide by 3 inches in diameter, which serves as an oil-groove, is cut at this time near one side of the bearing hole. The 9/32-inch radius at the base of the hub is also semi-finished, and the face of the flange finished to blend with this radius. After this machining operation is completed, the turret is again indexed and the crankpin hole reamed to a diameter of 2.918 inches plus or minus 0.001 inch, and the 9/32-inch radius at *D* finished to size. An accurate set of gages is, of course, provided for testing the work performed in each operation.

For the fifth operation, the work is held in a fixture mounted on a vertical boring machine. The hub is semi-finish-faced and the flange and radius at the base of the hub finished in this operation, leaving only a small allowance for final sizing operations.

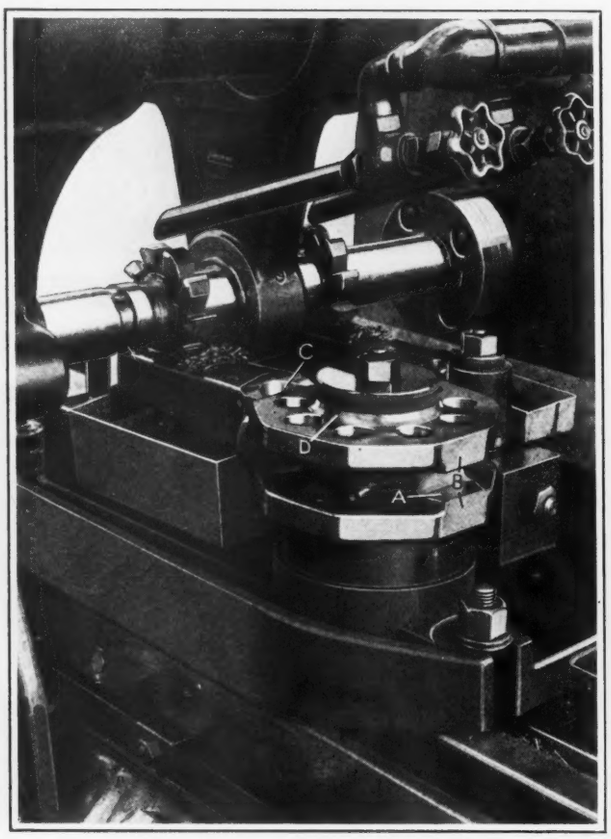


Fig. 1. First of Several Milling Operations Performed in Channeling the Sides of Master Rods

The sixth operation consists of straddle-milling the hub at the small end of the connecting-rod on a milling machine. The seventh operation is performed on a two-spindle drilling machine. In this operation, the piston-pin hole at the small end of the rod is first drilled to a diameter of 1 1/4 inches and then redrilled with a lip pilot drill to a diameter of 1 1/2 inches. The hole is next reamed to a diameter of 1.520 inches.

In the tenth operation, the master rod shown at *A*, Fig. 2, is located by the pin *B* which enters the bored hole at the small end, while the big end of the rod is located and clamped against the multiple drill bushing plate by the plate *C*, which is raised by means of the handwheel *D*. The special drilling head of the machine on which the fixture is mounted has ten drilling spindles located in groups of five each.

Rough-drilling Balancing Hole and Eight Knuckle-pin Holes

One group of drills is spaced to drill every other one of the knuckle-pin holes *A*, Fig. 3, through the flange, or to a depth of 5/8 inch, on one side of the rod and also to drill the balancing hole *B* to a depth of 1 15/16 inches. The drilling head is then raised and the rod reversed in the fixture for drilling the opposite side. The second drilling operation, with the fixture in the first position, results in drilling the balancing hole completely through the rod. After the drilling head is raised the second time, the indexing pin which locates the fixture in the first position is withdrawn by an upward movement of the lever *E*, Fig. 2.

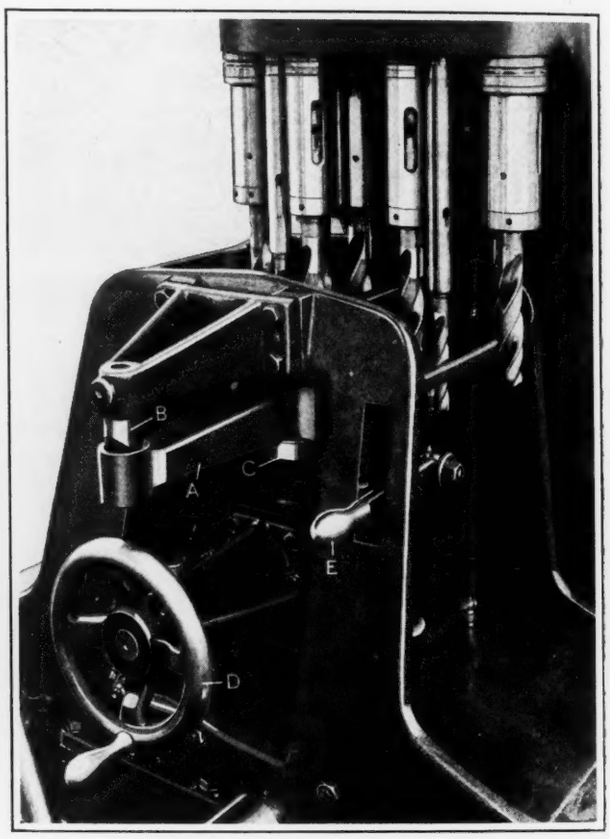


Fig. 2. Drilling Eight Knuckle-pin Holes with Two Groups of Drills Held in a Multiple-spindle Head

The fixture is next indexed or moved to the second position by means of a rack in mesh with a pinion on the shaft of a conveniently located spoked wheel. The lever *E* is then pushed down, causing the index or locating pin to position the fixture accurately under the second group of drills, after which the operation of drilling and reversing the work is repeated in order to complete the drilling of the eight knuckle-pin holes and the one balancing hole.

Forming Channels in the Sides of the Rod

Channels like the one shown at *C*, Fig. 3, are formed in both sides of the master rod by a combination of machining operations, the first of which is the eleventh operation. In this operation, the master rod is clamped in a fixture mounted on the table of a single-spindle drilling machine. The hole shown at *C*, Fig. 1, is produced on a drilling machine by first drilling with a 1 1/2-inch drill and then using a special counterboring tool, the end of which finishes the bottom of the hole to the correct depth with a fillet or radius of 3/16 inch between the sides and bottom. The depth of this hole is controlled by stop-collars on the cutters which are accurately positioned or located by means of set-up gages.

A similar hole is drilled to a diameter of 15/16 inch at the smaller end of the rod and counterbored with a tool similar to the one used for the large end, but having a diameter of 1 inch. After these operations have been completed on one side, the work is reversed in the fixture and the operations are repeated on the other side.

In Fig. 1 are shown two of the master rods clamped in a fixture on a plain milling machine for the twelfth operation. This is the first milling cut taken in forming the channel between the counterbored holes produced in the preceding operation. The cutters used for this operation are 1 inch wide by 4 1/2 inches in diameter, with a 1/8-inch by 45-degree chamfer at the sides.

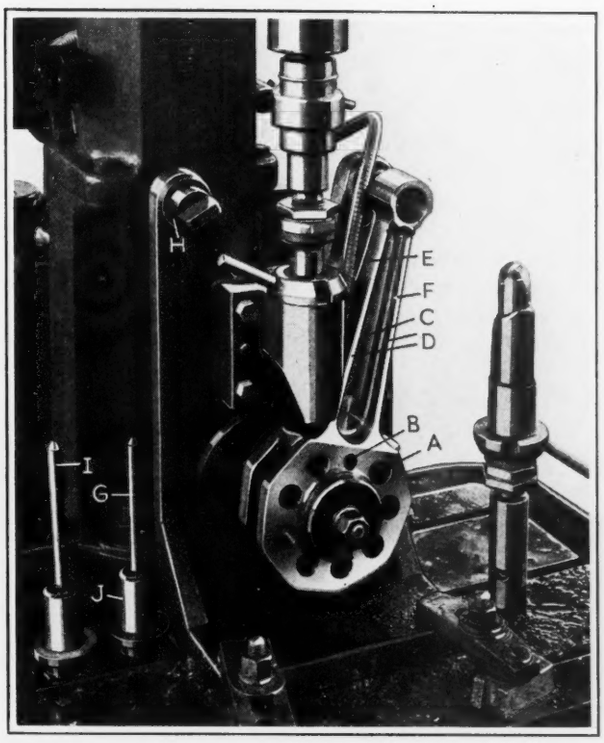


Fig. 3. Set-up for Drilling and Reaming Holes at Ends of Circular Slot Machined between the Rod Flanges

After completing the first cut, the pieces are reversed and the opposite sides milled in the same manner. Care is taken to stamp the heat number of the forging at the bottom of the counterbored surface at the large end of the rod before the number is removed by the second milling operation.

The surfaces *D*, Fig. 3, of the I-section at the sides of the channels milled in the preceding operation are next machined with an end-mill mounted on the spindle of a vertical milling machine, following which both sides *E* are milled to blend with the 1-inch radius surfaces at the sides of the rod and at both the large and small ends of the rod.

In the fifteenth and sixteenth operations, the sides *F*, of the channels *C* are rough- and finish-machined with end-mills to blend with the counterbores at the large and small ends, the I-sections on both sides being held to a thickness of 5/32 inch plus 0.005 inch.

Machining Inner Sides of Flanges

The set-up shown in Fig. 3 is for drilling and finish-reaming the holes *A*, Fig. 4, at each side of the rod. The rod is clamped on the fixture as shown in Fig. 3, and drilled to a diameter of 1 11/32 inches and to the required depth, as indicated by the flush-pin gage *G* when the body *J* is inserted in the drill bushing. A similar flush-pin gage *I* is used to gage the depth of the cut taken by the reamer employed to finish the hole to a diameter of 1.375 inches.

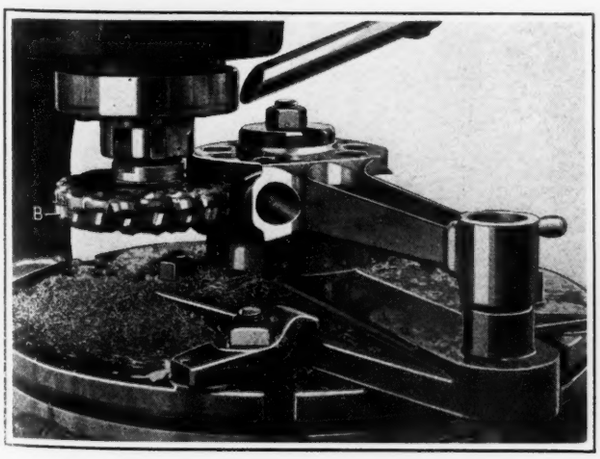


Fig. 4. Rough-milling the Slot Between the Master Rod Flanges

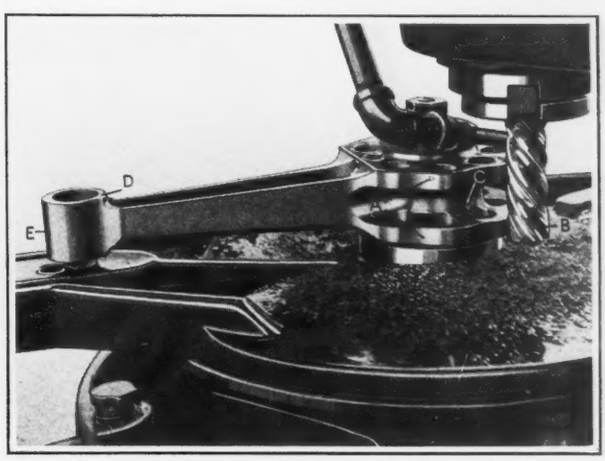


Fig. 5. Profile-milling the Master Rod Flanges with a Helical Cutter

The drill and the reamer used in this operation are provided with shanks that permit the tools to be interchanged quickly in the holder. After the hole is finished at one side of the shank, the position of the rod is changed for drilling and reaming the other side by locating the hole at the small end on the plug *H*.

When the holes have been drilled and reamed, the rod is mounted on the special fixture secured to the table of a vertical milling machine, as shown in Fig. 4. The special interlocking-tooth high-speed steel cutter *B* mills between the flanges as the table is revolved by power.

In Fig. 5 is shown the set-up for the nineteenth operation, which consists of profile-milling around the flanges *A*, with a 1 5/8-inch helical-tooth milling cutter. The profile is generated by revolving the table at the proper cutting speed while a cam of the required contour gives the table the necessary inward and outward movements.

The twentieth operation consists of finish-milling the hub *C* to a diameter of 3 3/4 inches and the inner faces of the flanges to a width of 1.370 inches within plus 0.003 inch of the specified size. A special interlocking type of cutter is employed for this operation.

Machining Small End of Rod

In the twenty-first operation, the small end of the connecting-rod at *E*, Fig. 5, is rough-milled to a diameter of 1 3/4 inches on a milling machine equipped with a special fixture. This fixture is also used for the next operation, in which surplus stock is removed at *D* with a 3/4-inch end-mill having a 3/16 inch radius at the end. The appearance of the small end of the rod at the completion of these operations is shown at *A* in Fig. 6.

Grinding Crankpin Bearing Hole

A chucking grinder is employed in the twenty-third operation to finish-grind the crankpin hole to a diameter of 2.937 inches plus or minus 0.0005 inch, and to finish-grind the face of the hub. The work is then reversed and the opposite face of the hub ground. A hollow mill mounted in a drill spindle is next used to form the wrist-pin ends at *B*, Fig. 6, to a radius of 1/32 inch.

Line-reaming the Eight Knuckle-pin Holes

Fig. 6 shows a master rod located in a fixture mounted on a drilling machine equipped with two multiple-spindle heads for rough and finish line-reaming the eight knuckle-pin holes. After rough-reaming the eight holes with the fixture in one position, the fixture is moved along into position for finish-reaming with the other group of reamers held in the second multiple-spindle head.

In the illustration, the guide bushing *C* of one of the reamers is raised to expose the reamer blades *D*. The reamers are all supported at the lower end by pilots *E* which fit into bushings in the fixture. Thus the reamers are supported and accurately guided on both sides of their cutting blades and as close to the blades as possible.

Spot- and Back-facing Clearances for Ends of Link Rods

The clearance surfaces *A*, Fig. 7, for the ends of the eight link rods are produced by first spot-facing with an end-mill ground to a radius of 13/16 inch, and then back-facing with a 13/16-inch radius counterbore inserted in the boring tool holder between the flanges. These operations are repeated for each of the eight positions. For the spot-facing operation, the rod is mounted on a fixture provided

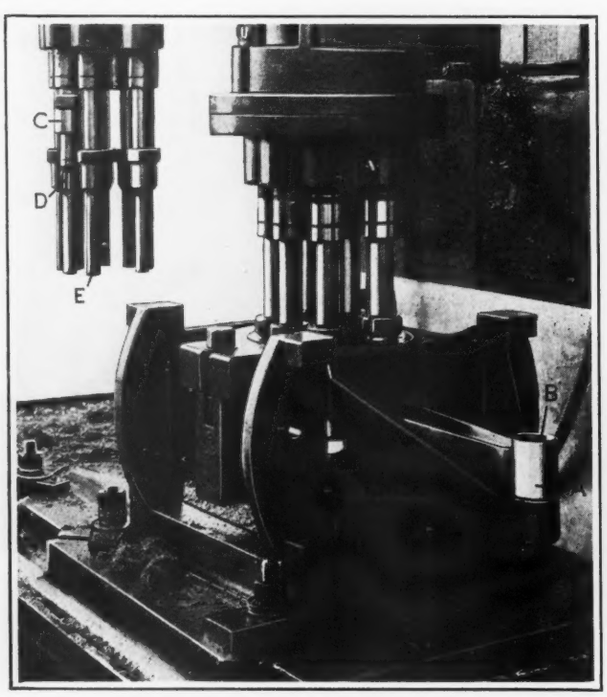


Fig. 6. Set-up for Rough- and Finish-reaming Eight Knuckle-pin Holes

Fig. 7. Flexible Shaft Grinder Being Used for Final Polishing Operation

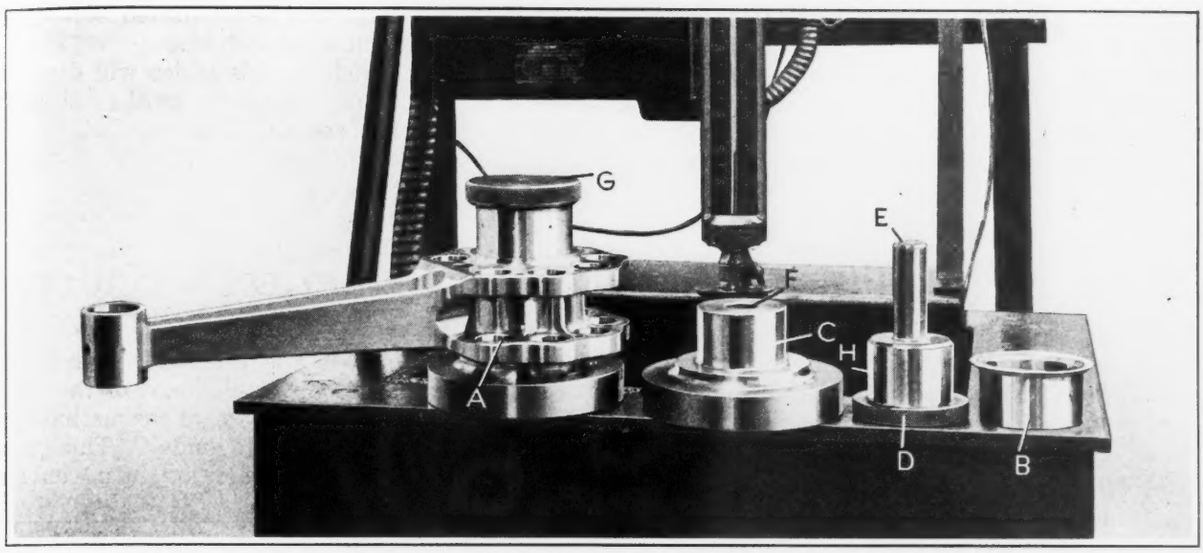


Fig. 8. Equipment Used in Assembling Bronze-lined Steel Bearing Shells in Master Rods

with means for indexing the rod accurately into position beneath the spot-facing tool.

Drilling and Tapping Holes in Flanges

For the twenty-eighth operation the rods go to a two-spindle machine equipped with drilling and tapping heads. This machine drills four 17/64-inch holes that are to be tapped for a 5/16 by 24 thread, and also three 1/4-inch holes. After these drilling operations, the jig plate is removed and all holes are countersunk 1/32 inch deep by 45 degrees. The rod is then reversed and the same operations performed on the opposite side. Two 5/16-inch holes are next drilled at *B*, Fig. 7, and a No. 19 hole drilled at *C*.

The thirtieth operation consists of drilling eight 1/8-inch oil-holes like the one shown at *A*, Fig. 8. These holes extend from the knuckle-pin holes in one of the flanges through the hub into the oil-groove in the crankpin hole. The four 17/64-inch holes previously drilled are now rough-tapped by hand for a 5/16-inch by 24-pitch U. S. standard form thread. After being rough-tapped, the holes are finish-tapped by hand.

Final Finishing and Polishing Operations

When the operation previously described has been completed, the master rods are taken to the bench, where all burrs that cannot be removed with a wheel or polishing jack are removed by hand. The inner surfaces of the flanges are also polished with a flat file covered with emery cloth. After the rod has been subjected to various tests and inspections, it is taken to a bench equipped with a flexible shaft grinder, as shown in Fig. 7. This grinder is used in polishing the clearance surfaces *A* for the link rods. The radius or fillet sections at each side of the I-section are also rough-polished by this tool.

The next, or thirty-fourth, operation consists of pickling the rod in order to expose any existing seams or cracks. Following this, the rod is subjected to a heat-treatment, being kept at a heat of from 350 to 400 degrees F. for 2 1/2 hours. After this treatment, the surfaces between the flanges and the radius surfaces on each side of the I-section are refinished with flexible shaft grinders.

A polishing jack is next employed to polish the rod all over. This operation must remove all tool marks around the edge of the I-section to a radius not greater than 1/32 inch. All sharp edges must be broken to approximately 0.010 inch. The next operation consists of finish-grinding the hole in the wrist-pin end of the master rod to a diameter of 1.535 inches plus or minus 0.001 inch.

This practically completes the machining operations on the master rod, which is now ready to undergo the exacting inspections and tests that every rod must pass before being placed in stock or on the assembly line. After being passed by the inspectors, the main crankpin bearing shells are pressed into position.

Assembling Flanged Bearing Shells in Master Rod

One of the two flanged bearing shells used on each master rod is shown at *B*, Fig. 8. This shell is of steel with a comparatively thin bronze lining which serves as the bearing surface on the crankpin. The equipment used in assembling the flanged bearing shells is shown in this illustration. The operation consists of heating the master rods to a temperature of about 300 degrees F. in an oil-filled tank. The oil is heated to the required temperature by an electrical heater provided with an automatic control.

After the rod has been thoroughly heated in the oil, it is placed over a mandrel such as shown at *C*. An assembling plug *D* with one of the shells *B* located on the hub *H* is then placed over the work with the pilot *E* in the hole *F*. Next, the bearing shell is forced into place by a soft-faced mallet or hammer. The assembling stud *G*, which is a duplicate of the one shown at *D*, is shown in position ready to force a bearing shell into one side of the master rod.

After the bearing shell has been assembled in one side, the rod is turned over quickly and another flanged shell forced into the opposite side. Two assembling studs *D*, with bearing shells in position, are placed within convenient reach before the work is withdrawn from the heating bath, so that the assembling operation can be completed before the rod has an opportunity to cool off.

A succeeding article in this series will describe some of the machining operations on the link rods, eight of which are assembled on the hub of the master rod.

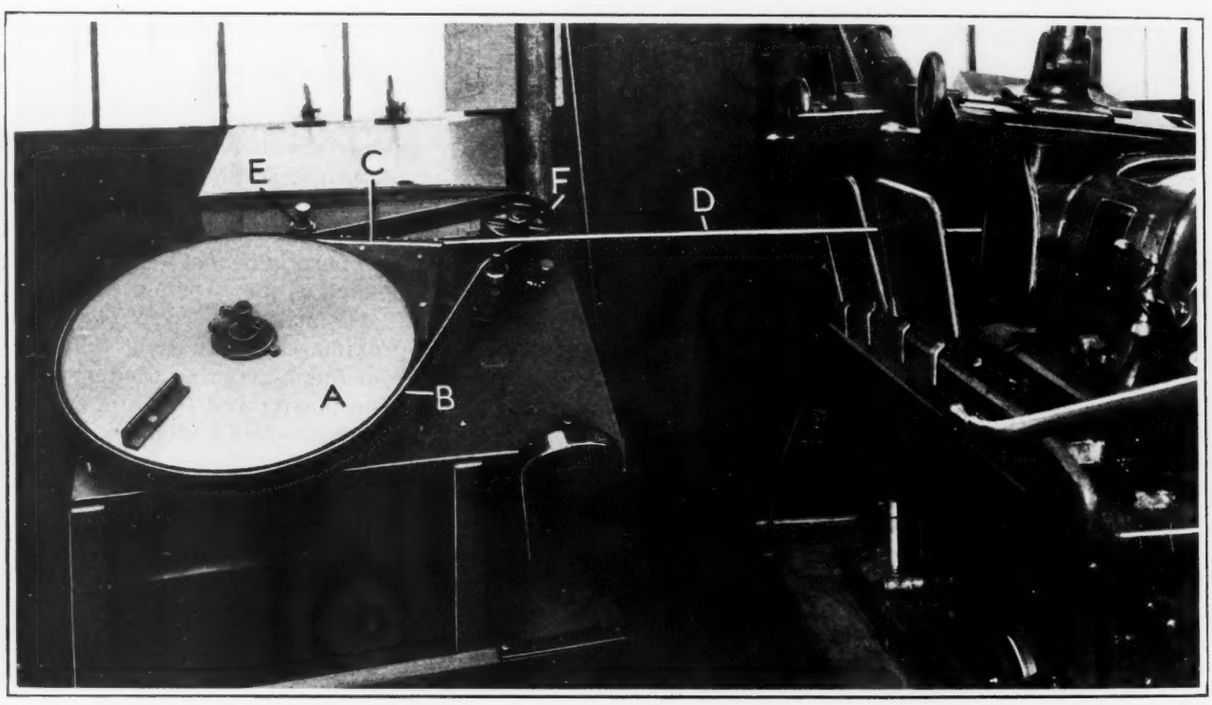
Feeding Bakelite Pins Through a Centerless Grinder

Bakelite pins for electricity resistor units made by the Allen-Bradley Co., Milwaukee, Wis., are ground in a centerless grinding machine after they have been formed in presses and baked. Prior to the grinding operation, these pins have a cross-section approximating an oval with the ends flattened. They are 1 5/8 inches long, and are ground to a diameter of 1/4 inch at the rate of 650 a minute.

The illustration shows the equipment employed for feeding these pins to the centerless grinding machine. They are loaded into a hopper which is formed by mounting a sheet-metal piece around disk *A* and the rotary table to which this disk is attached. Although the table and disk are driven constantly by means of belt *B*, the hopper piece remains stationary.

Disk *A* is somewhat smaller in diameter than the rotary table on which it is mounted, so that the Bakelite pins can fall between belt *B* and the periphery of the disk. The position of the disk on the table is also slightly eccentric, with the result that the table ledge on which the pins fall varies gradually from the greatest width to the narrowest.

As the table and disk are revolved at high speed, the Bakelite pins fall on the wide part of the ledge and are carried rapidly to the top of the mechanism, where they are discharged into guide *C*. This guide leads the pins into tube *D* which, in turn, conveys them to the wheels of the centerless grinder. At the point where the Bakelite pins enter the guide, there is a small idler pulley *E* which presses the driving belt *B* against the pins so as to pinch them slightly and discharge them into the guide with momentum. A stop on the hopper prevents two pins from entering the guide simultaneously.

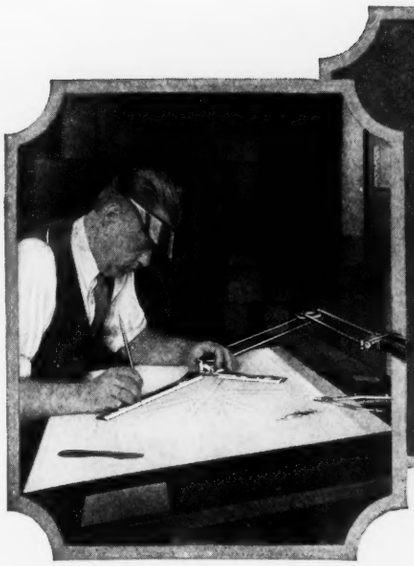


Mechanism Designed for Feeding Small Bakelite Pins to a Centerless Grinding Machine at the Rate of 650 per Minute

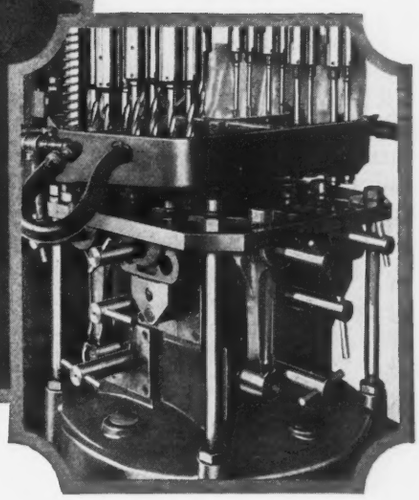
Power for driving this equipment is furnished by a 1/4-horsepower motor mounted on the shelf at the right-hand side of the stand. The drive is transmitted through shafting and bevel gears to the small pulley *F*.

* * *

The machine has made it possible for man to excel nature. Synthetic cellulose filaments can now be produced that are two and one-half times finer than those of real silk. It takes more than 4225 miles of this filament to weigh a pound.



Design of Tools and Fixtures



GRINDING FIXTURE FOR THREADING TOOLS

By HARVEY CHANDLER, Hollywood, Calif.

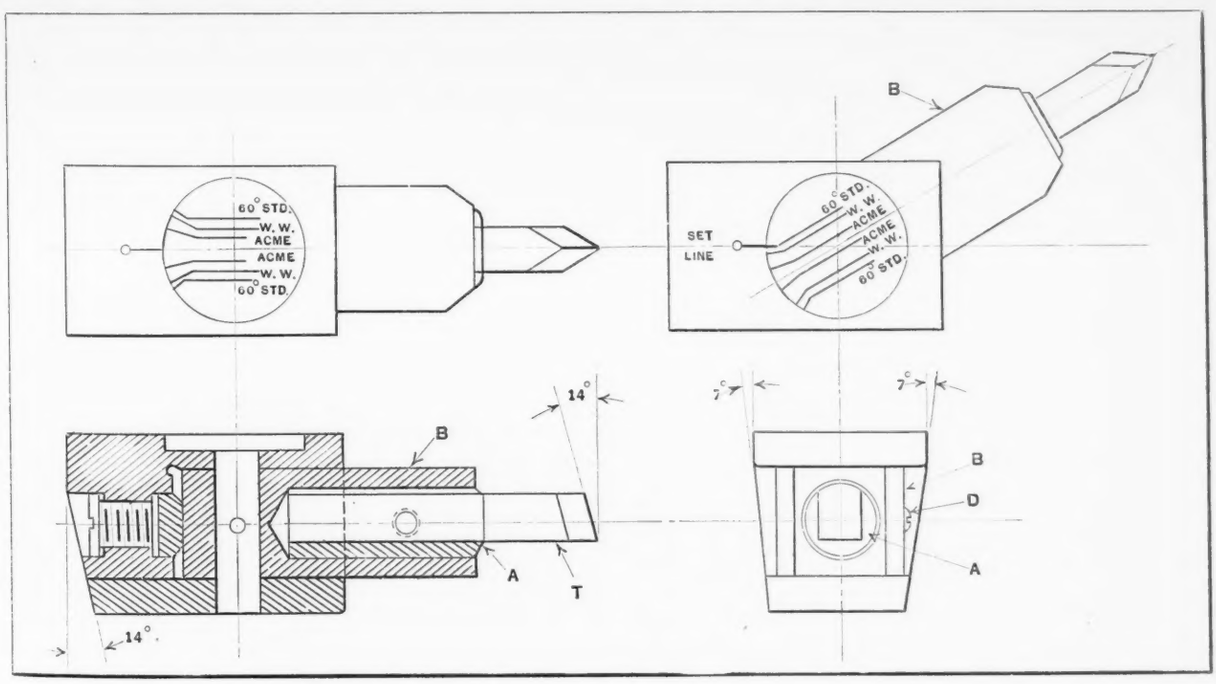
A fixture designed to facilitate the accurate grinding of square, Acme, Whitworth, and 60-degree threading tools is shown in the accompanying illustration. The body of the fixture is tapered on the sides to an angle of 7 degrees, as shown, to provide for grinding a clearance on the sides of the tool. The rear end of the body is machined to an angle of 14 degrees to provide clearance for the flat ground at the ends of Acme or U. S. standard threads. Should it be necessary to have larger side-clearance angles for coarse-pitch threads, the tool *T* and the clamping chuck *A* can be revolved in the holder *B* and clamped in the required position by means of the set-screw *D*.

A tool ground to the correct angle by using the fixture described can be resharpened without changing the form by simply grinding the top face. The lines or graduations for setting the tool-holder to the various angles required for the different thread forms are accurately positioned by using a sine bar. The views in the illustration are, of course, more or less diagrammatical.

WIRE-FORMING DIES

By FRANK V. KEIP, Adrian, Mich.

The wire-forming die shown in the accompanying illustration is used in producing circular rings like the one shown at *A*. Dies of this type are by no means limited to the forming of circular rings.

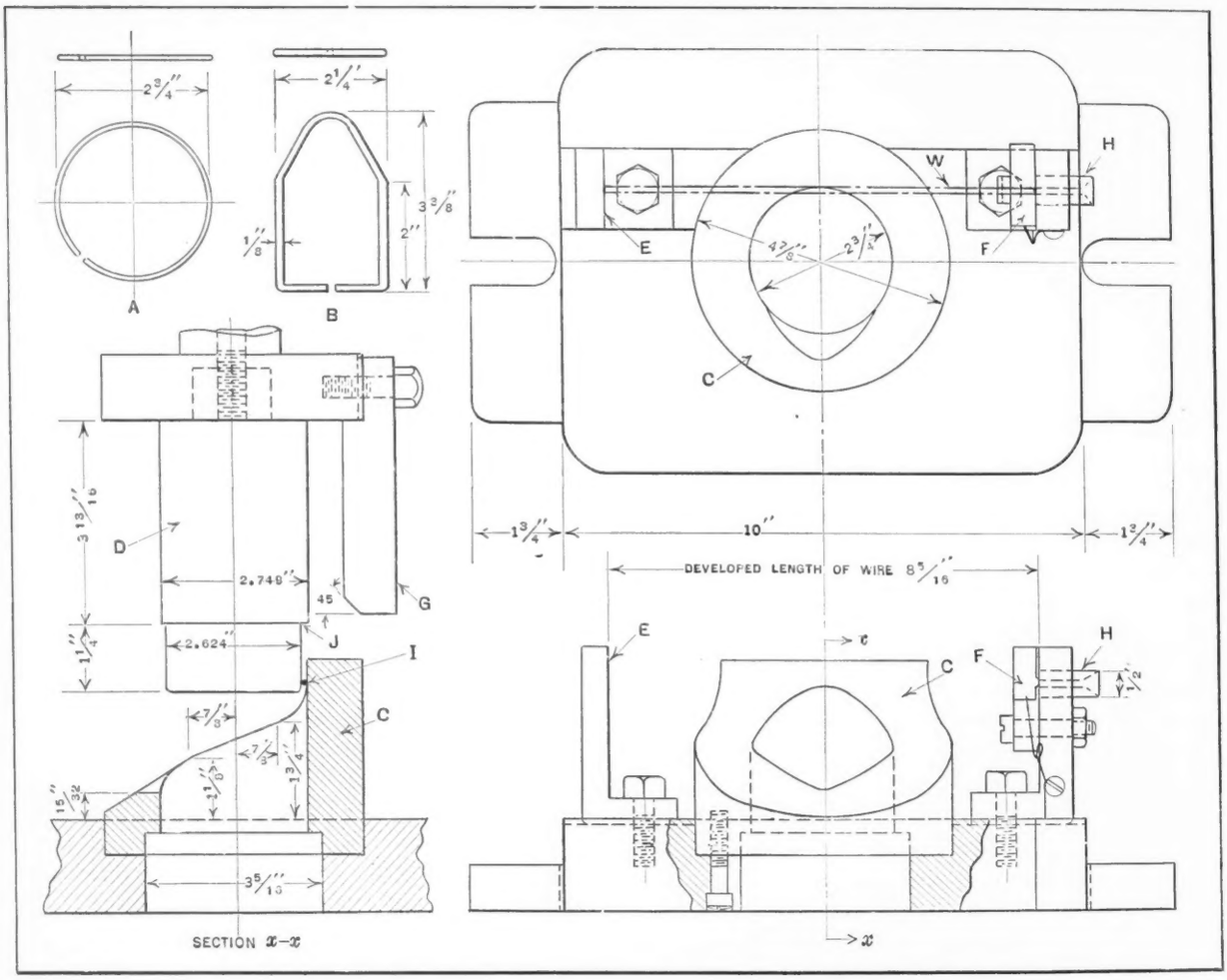


Adjustable Holder for Grinding Tools to Cut Threads of Different Forms

Parts such as shown at *B*, as well as more intricate shapes, are being made regularly in the plant where the writer is employed. Referring to the illustration, it will be noted that the lower die member *C* has a sloping or angular face. The punch *D* has a pilot-shaped end with a diameter approximately equal to the inside diameter of the ring to be formed. The main body of the punch is a close sliding fit in the die *C* and is approximately the same diameter as the outside of the ring.

The press runs continuously, the wire being fed into the die through the bushing *H* to the stop *E*. The rings drop out through an opening in the bed of the press. Although good work can be done on small wire, the larger sizes can be handled more readily on a forming die of the kind illustrated.

It is a simple matter for a toolmaker to construct the wire-forming die. The block *C*, shown in three views of the illustration, is a piece of high-carbon tool steel, bored out to a diameter of 2 3/4 inches, which is the outside diameter of the ring to be formed. The angle of the sloping face must be determined by experiment. When the face is machined to the correct slope, the wire will wrap itself about



Punch and Die Designed to Cut off and Form the Ring A from Round Wire Stock

Either hand or automatic feed is employed. On the downward stroke of the press ram, the cam *G* actuates the blade *F*, cutting off the wire, which is then in the position shown at *W* in the plan view and at *I* in section *x*–*x*. Actually, the punch is in a position somewhat lower than that indicated in section *x*–*x* when at the upper end of its stroke. For clearness, however, the punch is shown completely withdrawn from the die.

The continued downward movement of the punch, after the wire has been cut off, causes the shoulder *J* to force the wire to slide down the sloping face of the die and become wrapped around the pilot end of the punch. The wire is thus formed into a ring and carried down through the die by the shoulder *J*. the 2.624-inch end of the punch as it passes downward through the die.

The fillet or rounded surfaces at the ends of the straight portion of the die must be of the correct size. When properly designed and constructed, this type of die will not injure galvanizing, plating, or any other durable finish which may have been applied to the wire. The die-block *C* and the punch *D* should be carefully hardened and drawn slightly. When oil hardening steel is used, the temper need not be drawn at all. The main requirement of a press for wire-forming operations is that it should have a stroke of sufficient length to operate the die properly. In the particular die illustrated, a stroke of at least 3 inches is necessary.

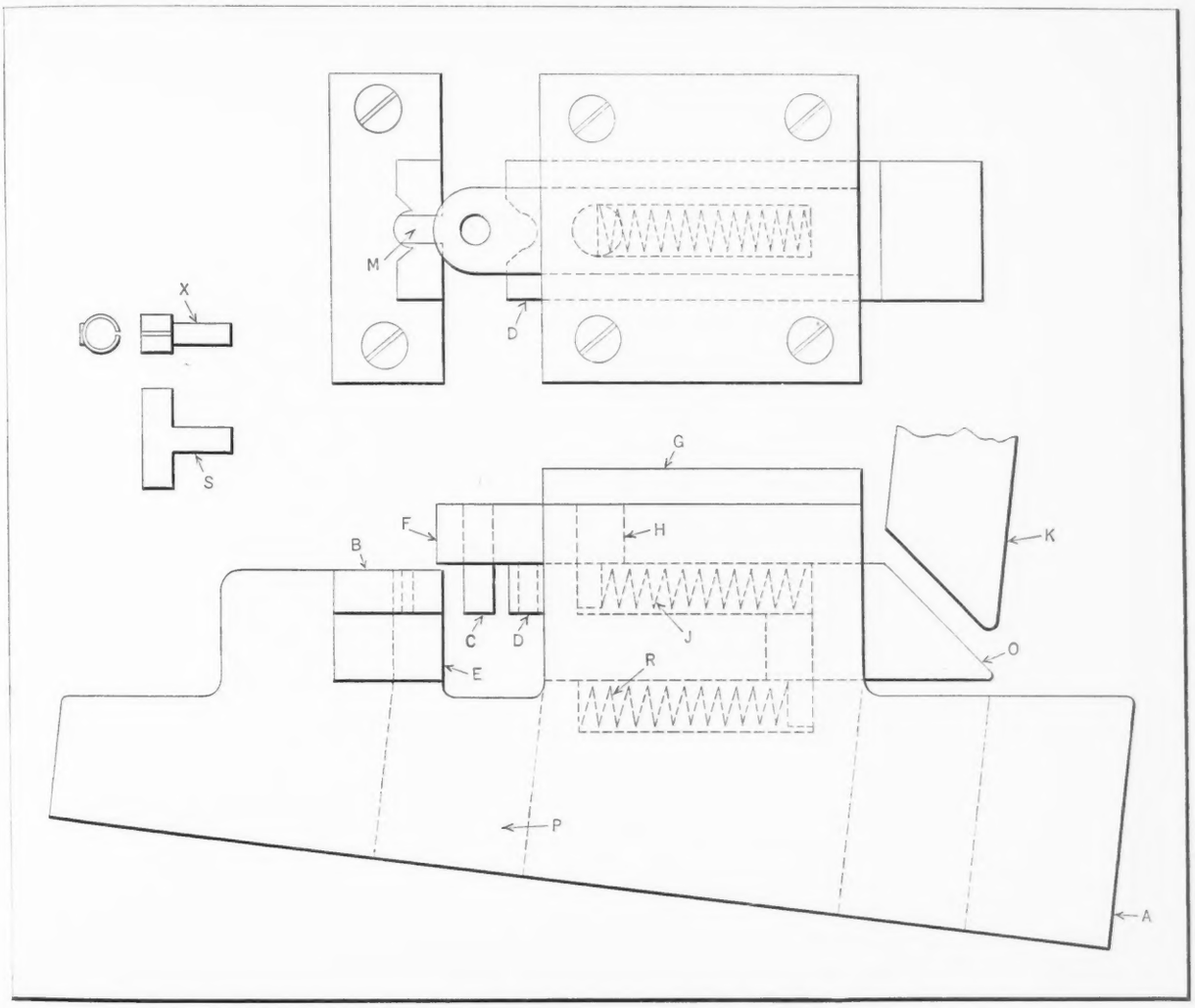
DIE FOR BENDING CIRCULAR SHAPED CLIP

By DONALD A. BAKER, Long Island City, N. Y.

In the illustration is shown a die for completely forming the small metal clip indicated at *X*. These clips are soldered on the ends of wire cables and serve as terminals. The metal from which they are made is half hard brass, about 1/64 inch thick, and therefore very easily bent; yet it has sufficient spring so that it will open up and not cling to the punch at the completion of the forming operation.

spring *J*, which is carried in a groove in the slide *O*. The pin *H* is a drive fit in slide *F*, and its projecting end is flattened to form an abutting surface for the spring. Punch *C* comes into contact with the work first and forms it into a U shape. Punch *C* continues to hold the piece in position until punch *D* comes forward and finishes the operation by closing the ends around punch *C*.

On the upward movement of the press ram, slides *F* and *O* return to the position indicated, through the action of spring *R*. As soon as it is



Die in which the Clip X is Formed at One Stroke of the Press

The die consists of a cast-iron shoe *A*, forming die *B*, forming punches *C* and *D*, nest plate *E*, punch slide *F*, cover plate *G*, spring pins *H*, springs *J* and *R*, and cam *K*. In operation, the blank *S* is dropped into die *B*, on top of plate *E*, with its narrow projection entering the slot *M*. In order to keep the blank in position against the die while loading, the die-block is tilted, the punches also being tilted a corresponding amount.

When the press is tripped, cam *K*, attached to the ram, descends and engages the angular surface on slide *O*, causing punch *D*, which is part of the slide, to move to the left. Slide *F* is also moved to the left with slide *O*, being backed up by the heavy coil

released, the finished part drops off punch *C* through a clearance hole *P* in the die-shoe and thence to a container on the floor.

FIXTURE FOR MILLING DIAMETRICALLY OPPOSITE SLOTS IN DISK

By CHARLES C. TOMNEY, New Brunswick, N. J.

The milling fixture shown in the accompanying illustration is used for milling the slots in the brass disk *A*. It produces accurate work and is inexpensive to construct. The disks are blanked from flat stock, after which they are gripped in the jaws *B*

of the fixture for slotting. The jaws which grip the work are formed by slotting a rectangular bar as indicated. This bar is turned down at *C* to a close turning fit in a reamed hole in the rectangular block *D*.

A collar *E* pinned to the outer end of the turned down section serves to hold the shoulder *S* of the chuck jaws tightly against the end of block *D*. The projecting end of the turned down section *C* is squared at *F* to receive a crank. When a disk is being placed in the jaws of the fixture, the crank is turned to bring the slot in a vertical position so that the work will clear the slitting saw *G*. The disk is positioned by the pins *H*, and the screw *I* is tightened to secure a firm grip on the work. After the work is in place, the slotting operation is performed by simply giving the crank one complete revolution. The bottoms of the slots are, of course, formed to a radius, but this is not objectionable.

A hand miller is perhaps the best machine on which to use the fixture described, as the hand-feed lever can be employed to move the saw away from the work for reloading. When a machine of this type is used, the disk should be turned so that it will clear the saw when the table is moved back to the stop. The slots are then cut by revolving the work as previously described.

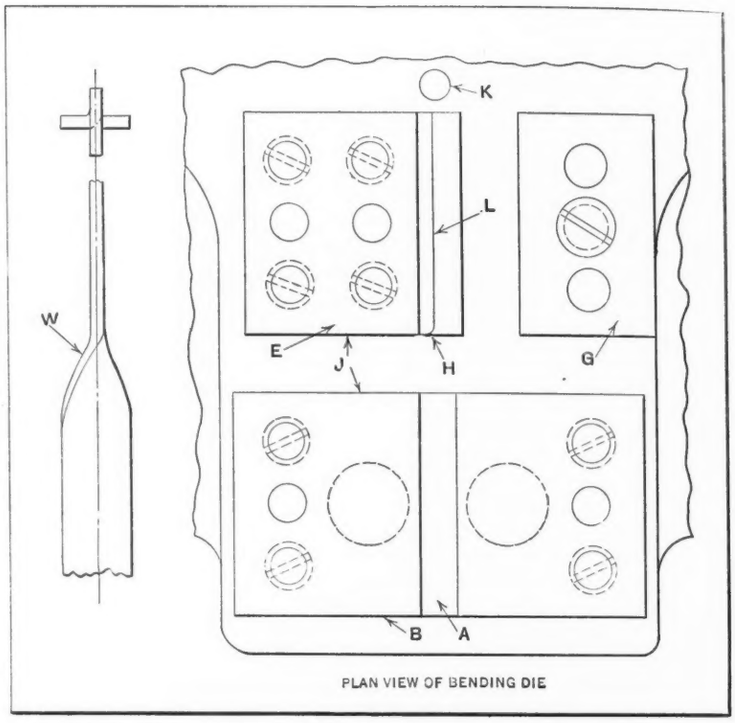
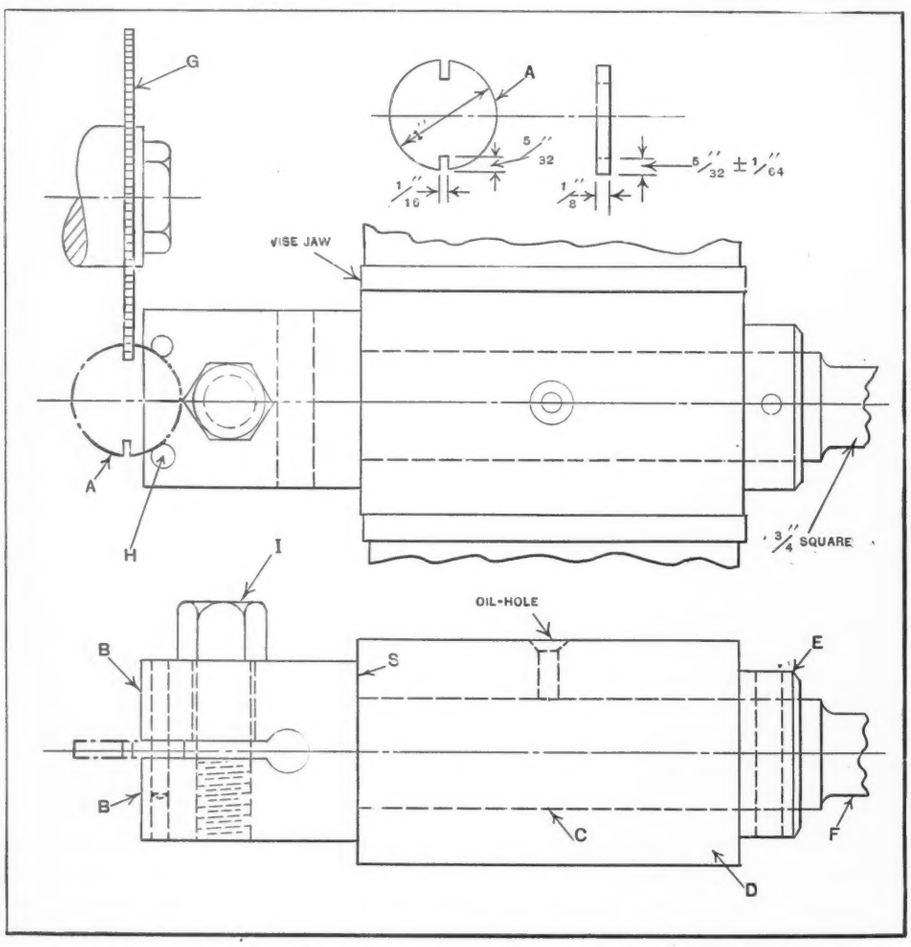


Fig. 1. Die for Producing Twist in Flat Strip as Indicated at W



Disk-slotting Fixture Held in Machine Vise Mounted on Milling Machine Table

SIMPLE TWISTING DIE FOR FLAT STRIPS

By LOUIS PICKETT
Irvington, N. J.

In Fig. 2 is shown a die designed to twist soft cold-rolled strip stock, 3/64 inch thick by 5/16 inch wide, as shown at *W*, Fig. 1. The die is very simple in design and consequently cheap to make and operate. The work is laid in the slot *A*, Figs. 1, and 2, of the block *B*, which is actuated by means of two springs *C*, Fig. 2. The depth of the slot *A* is less than the thickness of the material; thus when the punch-holder moves downward, the work is held securely by the movable block *D* before the twisting operation begins. It is also necessary that the block *B* have sufficient movement to allow the work to clear the bending block *E* when placed in slot *A*.

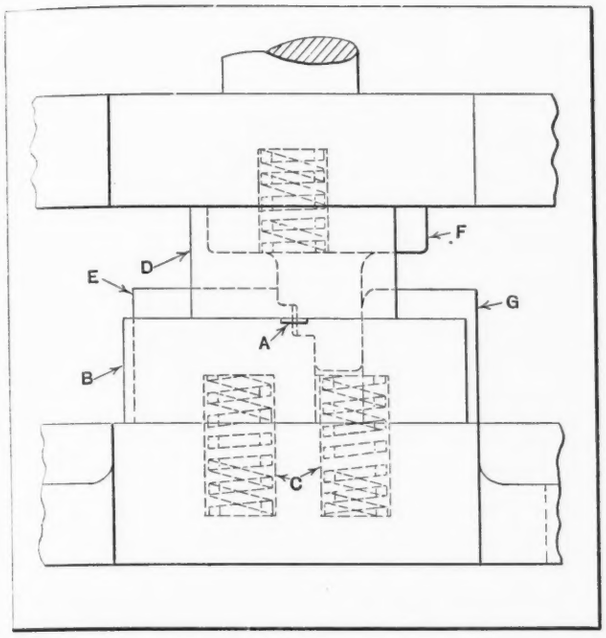


Fig. 2. Twisting Die with Punch at End of Down Stroke

The punch *F* twists the work by pushing it over the edge *L*, Fig. 1, of the block *E*. A rounded corner at *H* is necessary to insure satisfactory operation of the die. The punch *F*, Fig. 2, is reinforced by block *G*, which is held in place by two dowel-pins and a screw. The dowel-pins are large enough to resist the shearing action developed by the twisting operation.

It will be noticed that the work is held in a recess after it is twisted. If it were not for this recess, the work would be bow-shaped, owing to the flexibility of the metal. After the work is twisted, the upper part of the recess strikes the work, bringing it down so that the edge of the twisted portion is parallel to the plane of the original portion. The distance *J*, Fig. 1, depends on the nature of the work, as does also the location of the stop-pin *K*.

FIXTURE FOR ALIGNING BUSHING IN AN ARBOR PRESS

By GEORGE L. PYRITZ, Indianapolis, Ind.

The fixture here illustrated was designed by the writer for the purpose of pressing the bronze bushing *A* into the blind hole *B* in an automobile water pump body. To prevent scoring or distortion of the bushing, it must be held in correct alignment with the hole while it is being pressed in. The pump casting cannot be supported on any of the surfaces *C* because of their unfinished condition, and also because they are not flat.

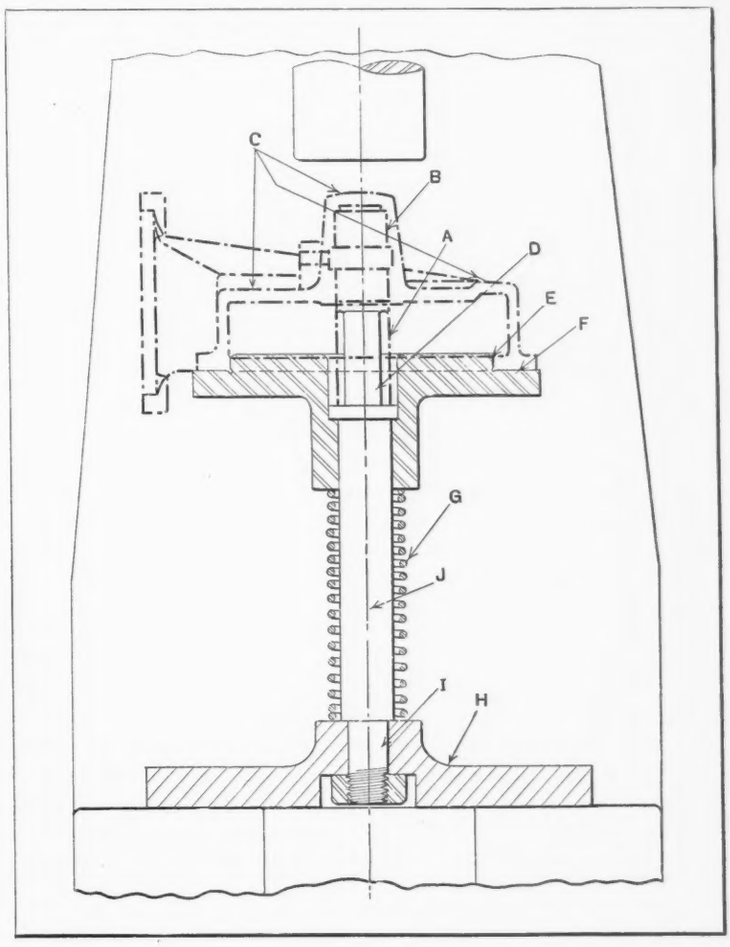
However, with the simple fixture shown, the bushing can be pressed into the hole quickly, and it will be held in alignment during the process. This fixture has another advantage in that it can be rapidly loaded. It is placed directly under the ram of the press and the bushing *A* slipped over the end *D* of the stem *J*, after which the pump casting is centered over the rabbet *E*.

The ram of the arbor press is then moved down against the casting. As the ram continues to descend, the plate *F* is forced downward, compressing the spring *G*, while the stem *J* and the bushing remain stationary. When the bushing reaches the bottom of the hole in the casting, the ram is raised and the spring carries the plate *F* back to its normal position, after which the work is removed.

The cast-iron baseplate *H* is bored to receive the shank *I* of the stem *J*. This stem is made of low-carbon steel, hardened and ground, the lower end of the shank being secured in the base by a nut, while the upper part is a sliding fit in plate *F*. The latter is also made of low-carbon steel, all wearing surfaces being hardened and ground.

* * *

Farm tractors are not a new idea. Back in the fifties, John Fowler, an Englishman, expended some $350,000 in experiments to substitute steam engines for horses in cultivating farm lands, but this early attempt was not successful.



Arbor Press Fixture in which Bushing is Pressed into a Blind Hole

Facts About Bearings and Bearing Metals

Composition of Bearing Metals, Bearing Clearances, and Other Factors to be Considered in Attaining Maximum Bearing Efficiency

By J. D. LLOYD, Lubricating Engineer, U.S. Fuel & Metals Corporation, Denver, Colo.

PROBABLY as much power is wasted by using bearings of faulty design and by not keeping bearings in proper condition as is lost through inadequate or ineffective lubrication. Selecting the proper bearing metals, providing just the proper clearances, maintaining the bearings in accurate alignment, and keeping them supplied with a sufficient amount of suitable lubricant are all important factors that are too well known to require other than brief mention here. Nevertheless, the selection of a bearing of the proper design and the use of a bearing metal of the correct composition to meet the needs of a particular machine or unit are matters that are seldom given the amount of consideration they deserve.

The fact that there is a right and a wrong way to reline an old bearing is a matter that frequently is given little thought. The best remedy for hot boxes and the methods of dealing with various other problems connected with the selection, use, and maintenance of bearing metals are still other subjects which seldom receive proper attention. Much has been written regarding bearings and bearing metals, but many of the articles published on these subjects have been largely theoretical or based on the results of research work, which is of little interest to the busy plant executive. The present article will deal with the practical side of this work, keeping the theoretical considerations in the background as much as possible.

Table 1. Approximate Analysis of Various Bearing Metals

Name of Bearing Metal	Lead, Per Cent	Tin, Per Cent	Antimony, Per Cent	Copper, Per Cent	Zinc, Per Cent	Phosphorus, Per Cent
Ex. B. Metal	15.0	8.0	....	76.8	....	0.200
Ajax Metal	11.5	11.5	....	77.0	....	0.037
No. 1 Babbitt	80.0	20.0	....	....	....	.....
No. 5 Babbitt	0.5	68.0	....	1.0	30.5	.....
Car-brass Oil Lining	84.9	....	15.1	....	....	.....
No. 1 Bronze	11.5	11.5	....	77.0	....	.....
No. 5 Bronze	....	15.0	....	85.0	....	.....
Carmelia Metal*	15.0	4.5	....	70.0	10.0	.....
Ajax Plastic Bronze	30.0	5.0	....	65.0	....	.....
"S" Bearing Metal	9.5	10.0	....	79.7	....	0.8
White Metal	82.0	....	12.0	6.0	....	.....
No. 3 Babbitt	70.0	10.0	20.0	....	....	.....

*Contains 0.5 per cent iron.

Types of Bearings

The word "bearing" in its general meaning indicates a support. Bearings are essential to the transmission of power by shafting, and upon their selection and care depends the operating efficiency of every industrial plant. Actually, a bearing is that part of a machine that supports and controls the motion of a moving part. Although numerous varieties of bearings, operating under a wide range of speed, pressure, and temperature conditions are in use—all of which makes classification difficult—the types of bearings can be classified in accordance with the manner in which they control the motion of the part, as follows: (1) Radial bearings; (2) thrust bearings; and (3) guide or slipper bearings.

Radial bearings hold the axis of a revolving part or journal in a fixed position. Thrust bearings resist any force tending to move a rotating member in the direction of its axis. Guide or slipper bearings limit the motion of the part to a straight line.

Friction and Non-friction Bearings

Bearings of the classifications mentioned may be further classified as being either of the frictional or of the non-frictional type. If the bearings are so constructed that the parts fit rather closely and act directly one on the other, with a lubricant between, they are of the frictional type, but if the parts are separated by rolling members, such as balls or rolls, they are non-frictional bearings.

Table 2. Clearances for Horizontal Cylindrical Bearings*

Diameter of Shaft, Inches	Maximum Clearance, Inch	Minimum Clearance, Inch
Up to 1 inch	0.0020	0.0010
1 1/8 to 2	0.0035	0.0015
2 1/8 to 3	0.0040	0.0020
3 1/8 to 4	0.0050	0.0025
4 1/8 to 5	0.0060	0.0030
5 1/8 to 6	0.0080	0.0040
6 1/8 to 7	0.0110	0.0045
7 1/8 to 8	0.0120	0.0050
8 1/8 to 9	0.0140	0.0060
9 1/8 to 10	0.0160	0.0080
10 1/8 to 15	0.0190	0.0090
15 1/8 to 20	0.0200	0.0150

*Clearance equals difference between diameters of shaft and hole.

The effective functioning of frictional type bearings necessitates the use of materials that will have little abrasive effect on each other when the surfaces rub together. The present article deals primarily with frictional type bearings.

Bearing Metals

If a perfect oil film could be maintained between the rubbing surfaces of friction bearings, the composition of the metal surfaces would not be of such importance. Unfortunately, however, it is very difficult to keep a perfect lubricating film between the bearing surfaces, and as a result, some wear takes place. The extent or amount of this wear

depends upon the composition of the bearing metal. It is preferable that the journal and the bearing should be of dissimilar metals, the bearing surfaces being made of a softer metal than the journal. Thus, any wear that takes place will be confined principally to the bearing surface, which is cheaper to replace than the journal.

The bearing metals generally utilized are babbitt metal, phosphor-bronze, gun-metal, manganese, bronze, or brass. The approximate analysis of various bearing metals is given in Table 1.

The "S" bearing metal listed in this table is an acid-resisting alloy. It may be mentioned in connection with this metal that the difficulties ordinarily encountered in making castings increase in proportion to the amount of phosphorus which they contain. The bearing metal that is designated as Ex. B metal is used for car journal bearings and for cases where the metal is required to resist the action of acids. The Ajax plastic bronze bearing metal is also used for car journal bearings. A bearing lined with bronze containing lead is said to be less liable to heat under the same conditions of lubrication than one containing no lead. Alloys containing a high percentage of antimony are suitable for use in heavy-duty machinery, as they are harder than those containing only a small percentage of this metal.

Generally, babbitt, which is a soft and fusible metal, is used for journal bearings employing soft steel journals. This metal is given the required toughness and hardness by its tin content; strength, by the presence of copper; and hardness and brittleness, by antimony. It has an advantage over the other hard bearing metals in that it can be made to form a perfect bearing in line with the shaft at very low cost.

However, it must be remembered that there are many brands and several qualities of babbitt metals on the market and that ordinary babbitt metal varies greatly in its composition. Therefore, babbitt should be purchased in accordance with a definite formula that past experience has shown to be entirely satisfactory.

Materials Used for Unlined Bearings

For unlined bearings, where speeds and pressures are fairly high, a phosphor-bronze composed of 80 per cent copper, 10 per cent lead, and 10 per cent tin, and deoxidized with phosphorus, is widely used. A common practice is to use hard steel journals with cast-iron bearings. Bearings so made have given good service, it being found that the cast iron becomes glazed on the bearing surface so that the friction between the bearing and journal is very low, resulting in a reduction in the amount of wear. However, cast iron is very brittle, and therefore will not stand up under severe shocks without cracking.

From the standpoint of low friction, lead, due to its soft yielding properties, is one of the most satisfactory of bearing metals, although lead alone is not a suitable bearing material, because it has insufficient hardness or toughness. Hence, it must always be combined with some other metal to obtain the required hardness. In cases where the high temperatures and pressures would cause bearing metals, such as babbitt, to melt and run from the bearing, it is the practice to use "brasses" which are equipped with a crown of soft metal. This crown of soft metal absorbs the wear while the brasses give the required strength.

Determining Bearing Clearances

All bearings should have sufficient clearance to prevent binding or "freezing." The diameter of the journal, the coefficient of expansion of the metal composing it, and the probable range of temperature under running conditions are the principal factors that determine the amount of clearance required for a bearing. The following coefficients of expansion can be used in the absence of more specific data from the manufacturer of the material employed:

Nickel steel (10 per cent nickel) . . . . 0.0000073 inch
Bessemer rolled hard steel . . . . . 0.0000056 inch
Bessemer rolled soft steel . . . . . 0.0000063 inch

The foregoing values represent the coefficients of expansion per inch of diameter per degree F.

Example—Let it be assumed that a shaft of 10 per cent nickel steel, 5 inches in diameter, is to run in a bearing where the temperature ranges from 75 to 215 degrees F. This represents a difference in temperature of 140 degrees F. What should be the amount of clearance, or the difference between the diameters of the shaft and the bearing?

Answer—The formula for obtaining the bearing clearance is as follows: Multiply the coefficient of expansion by the diameter of the journal and then multiply the product thus obtained by the range in temperature.

Applying this formula to the example given, we have

$$0.0000073 \times 5 \times 140 = 0.00511 \text{ inch}$$

For the average horizontal cylindrical bearing, satisfactory results are generally obtained if the bearing clearances are within the range given in Table 2. For vertical cylindrical bearings, the clearance is from 0.001 to 0.004 inch less for the range of sizes given in Table 2.

* * *

CLEVELAND BRANCH OF DIE AND TOOL ASSOCIATION ELECTS OFFICERS

The Cleveland branch of the National Die and Special Tool Builders' Association recently elected A. E. Shepard of the Sommer & Adams Co., chairman; F. C. McKinney of the McKinney Tool & Mfg. Co., vice-chairman; C. R. Decker of the C. F. Laganke Co., treasurer; and A. J. Mertz of Danly Machine Specialties, Inc., secretary. A membership committee and a standardization committee for the purpose of suggesting standardized worksheets for jigs and fixtures have been appointed.

Ideas for the Shop and Drafting-room

Time- and Labor-saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

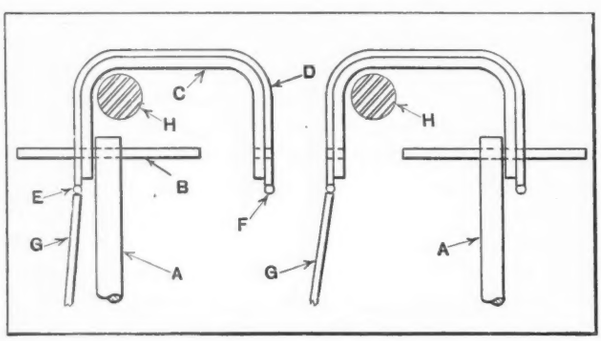
LIFTING BELTS OVER HIGH SHAFTS

The method of using a device developed by the writer for lifting or passing a belt over a high shaft is shown diagrammatically in the accompanying illustration. This device has proved especially useful when machines are grouped close together and when it is difficult to use a stepladder without stopping some of the equipment.

The essential parts of the device are a length of iron pipe *A*, which serves as a handle; a piece of flat strap iron *C;* a square bar *B;* and a short length of belt *D* riveted to *C*, which has belt connectors at *E* and *F*. Pipe *A* has a square hole at the upper end which is a tight drive fit on bar *B*. The C-shaped flat iron piece *C* also has a square hole near each end which is a sliding fit for bar *B*. The belt fasteners *E* and *F* are of different sizes and are selected to suit the two widths of belts that are used in the shop.

After a belt has been repaired, one end *G* is attached to the device by slipping the connecting pin into place in the fastener at *E*. The device is then raised and slipped over the shaft *H* with the handle *A* in the position shown in the view at the left. The handle is then pushed to the right, causing bar *B* to enter the square hole in the opposite side of part *C*. With handle *A* in its new position, as shown in the view to the right, it is a simple matter to raise the device so that the end of belt *G* can be passed over shaft *H*.

The square bar *B* is, of course, of sufficient length to prevent the device from becoming disassembled;



Diagrams Showing Method of Using Device for Passing Belts over High Shafts

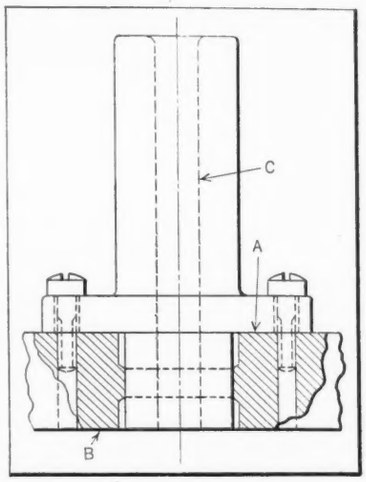
in other words, one end will enter the square hole at one side of member *C* before the opposite end clears the hole at the other side. By having the square bar *B* fit into a square hole, the member *C* is forced to remain in a vertical position, as shown in the illustration.

Hamilton, Ont., Can. H. MOORE

ACCURATE REAMING WITH A MASTER PLATE

In reaming holes in jigs, fixtures, etc., master plates are sometimes used to guide the reamer accurately. Otherwise a slight angularity in the hole may result if the drilling machine spindle is worn or the table out of square.

In the illustration is shown a guide bushing used in conjunction with a master plate. This plate is made of well seasoned cast iron and is bored to receive the guide bushing. In order that the bushing may not be cramped and prevented from seating itself correctly on the flange *A*, both ends of the hole in the plate are relieved, leaving only a part of the original bore in contact with the bushing. Great care is taken in facing the flange *A* to have it absolutely square with the guide hole *C*.



Master Plate which Eliminates Angularity in Reamed Holes

In use, the master plate is clamped with its surface *B* against a finished surface on the part to be reamed. Owing to the great length of the guide bushing, it is obvious that there will be very little angular deflection of the reamer. These master plates may be made up with single bushings and clamped in different positions for reaming several holes; or a group of holes may be reamed simultaneously with one plate by employing the required number of guide bushings.

In order to reduce the wear in the bushings and to maintain accuracy, it is suggested that reamers of the end cutting type be used, as those with cutting edges along their length will soon change the size of the guide holes and give inaccurate results.

R. B. WILLIS

PREVENTING LEAD FROM ADHERING TO STEEL PARTS

To prevent lead from adhering to the surface of steel parts as they are removed from a lead bath, the writer advocates the application of a coating of whiting and wood alcohol before the parts are immersed in the bath. This mixture is far superior

to that of water and whiting, because it does not sputter as the water mixture is likely to do if the parts are not quite dry before they are placed in the bath. Moreover, the alcohol mixture is far more adhesive than the water mixture.

Billericay, England — W. E. WARNER

A PRESERVATIVE FOR MANILA ROPE

Manila ropes are made of long, tough vegetable fibers, which are twisted into strands and the strands then twisted into cables or ropes of varying diameters and tensile strengths. A very good preservative for manila ropes, which is suitable also as a rope dressing, may be made as follows:

Rosin oil	2 gallons
Pine tar	1 gallon
Oil myrbane	6 ounces
Mineral oil	7 gallons

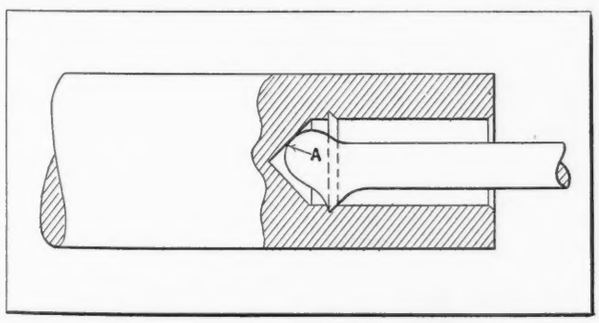
The preferred mineral oil is one made from an asphaltic base crude oil having a viscosity of 60 seconds at 210 degrees F., and a pour test of about 30 degrees F.

Denver, Col. — H. L. KAUFFMAN

SIMPLE RECESSING TOOL

In the accompanying illustration, is shown a simple tool used on a screw machine for cutting a recess near the bottom of a long hole of small diameter. The shape of this tool is such that when it comes in contact with the bottom of the hole, the angular surface left by the point of the drill crowds the tool sideways. This action causes the cutting point of the tool to feed into the side of the hole and cut the required recess.

In order to obtain satisfactory results, it is better to grind the drill used for the hole to a sharper angle than is ordinarily used. The projection *A* on the tool must also be made the correct shape, so



Recessing Tool which is Fed against the Side of the Bore by the Angular Surface Left by the Drill Point

that it will have a one-point contact with the bottom of the hole while the recess is being cut. Moreover, this projection must be highly polished and rounded so that the cutter will not chatter.

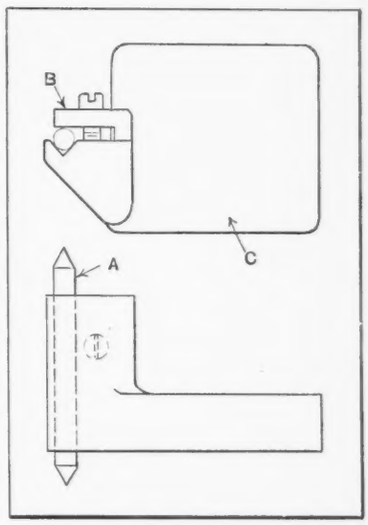
A recessing tool of this type permits the manufacture of bushings having the holes countersunk without a separate operation, which results in a considerable saving in cost.

Elizabeth, N. J. — R. A. HEYDEN

HOLDER FOR DIEMAKER'S CENTERING PUNCH

A locating tool of interest to diemakers, especially those engaged in making sub-press dies of the guide pin type, is shown in the accompanying illustration. In making dies of this kind, where blanking and piercing punches are frequently combined in the same die, or where a number of piercing punches only are used, it is sometimes convenient to secure both the die and punch plate in the sub-press before locating any of the piercing punches.

With the tool illustrated, the holes for the piercing punches can be readily located in the following manner: With the sub-press assembled and the die and punch plates in place, the tool is so located that the double-ended center-punch *A* is directly over one of the piercing holes in the die.



Double-ended Centering Punch and Holder

The punch is held very lightly by the clamp *B* against the V-groove in body *C* of the tool, and when the body *C* is in proper contact with the top face of the die, the center-punch is grasped in the fingers and forced downward until it enters the piercing hole in the die. This action accurately centers the punch in the hole. The two halves of the sub-press are then brought together so that the top end of the center-punch makes an impression in the punch plate which can afterward be trued up in the lathe with an indicator.

By using the method described, all the holes for the punches can be quickly and accurately located in the upper member with the assurance that they will match the holes in the piercing die. The V-block construction of the centering tool is considered better than mounting the punch in a slip-fit hole, as the two sides of the V-groove can be readily ground square with the base. It will be noted that the tool is so constructed that it can be used for locating holes that are close to a blanking punch or other member.

Long Island City, N. Y. — DONALD A. BAKER

* * *

The research problem is not solved with apparatus. No one has ever solved anything in a research laboratory. It is solved in a man's head. The research laboratory is the means through which likely ideas may be made practicable.—*Charles F. Kettering, vice-president and director, General Motors Corporation.*

Questions and Answers

RESTORING OIL-SOAKED MOTOR COILS

O. B. S.—What is the best way to restore the insulation of the armature and field coils of electric motors that have become oil soaked? Can gasoline be used satisfactorily for cleaning the coils and what is the best way of applying the cleaning fluid?

Answered by R. H. Parrish, San Antonio, Tex.

The satisfactory restoration of the insulation of armature and field windings after being oil soaked depends on the type of insulating material used—that is, whether it is a soft cotton braid covering over rubber, which has been only slightly baked, or an enameled wire with special impregnated insulation, which has been extremely well baked.

In the case of cotton covered wire coils, the removal of the oil will probably destroy the cotton insulation in places and result in a breakdown of the insulation when the motor is put in use. With wire coils having enamel insulation, a careful cleaning with gasoline, using an air cleaning spray-gun, followed by thorough baking, would be satisfactory for either direct- or alternating-current motors.

HARDNESS OF ELECTRO-DEPOSITED COATINGS

V. S.—What is the best method of measuring the hardness of very thin coatings of electro-deposited metals? When so measured, what is the comparative hardness of electro-deposited chromium, nickel, copper, cobalt, tin, and cadmium? How does this hardness compare with the hardness of ordinary machinery steel, copper sheets, bronze castings, and rolled brass bars?

Answered by L. K. Wright, Jackson Heights, Long Island, N. Y.

The best method of ascertaining the hardness of thin coatings of any metal or alloy deposited on a base of dissimilar metal is by means of a low-powered magnifying glass and a series of hardened "scratch pins." When normal pressure on a scratch pin does not produce a scratch that is visible under the magnifying glass, the relative hardness may be said to be slightly in excess of that of the particular "scratch pin" used.

The hardness of an electro-deposited coating depends upon the crystal formation, rate of deposit, temperature, current density, agitation of the solution, thickness, hydrogen inclusions, etc. Thus two samples plated in the same bath with the same anodes, under different temperature, current density, and solution agitation will have a different hardness. For instance, either relatively hard or soft chromium plating is obtainable by controlling these factors. When a definite hardness is required, the plating must be done under controlled conditions, preferably with an automatic machine plater, keeping a careful check on the solution. Hardness testing methods, such as indenting the sample by means of a ball or cone, give entirely erroneous results when applied to electro-deposited coatings, as the readings depend upon the hardness of the metal on which the coating is deposited.

MACHINES GUARANTEED TO PROVE SATISFACTORY

J. J. M.—Please explain the legal effect of the insertion in a sales contract of the following: "This machine is guaranteed to be satisfactory to the purchaser." We sold a machine and this notation was inserted in the contract. Now the purchaser refuses to pay for it, contending that it is not satisfactory. We know that it is a good machine and the buyer should be satisfied. We think he has changed his mind about wanting it and desires to return it.

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

It is well established that a notation in a contract of sale, or a written order that the merchandise shall be satisfactory to the purchaser, means that the goods shall be of such quality that it will prove satisfactory to a *reasonable* purchaser, in consideration of the agreed price.

In a recent case (136 Atl. 37), it was disclosed that a seller included in the contract of sale the words "quality satisfactory." The buyer refused to receive and pay for the merchandise on the grounds that the quality of the goods was not satisfactory. The seller filed suit against the buyer, contending that the quality was as fair as might be expected by a reasonable purchaser, in consideration of the price. The seller also proved that the buyer was able to buy the same goods at a lower price. The higher Court held the purchaser bound to accept and pay for the merchandise, saying:

"In the case at bar, the clause, 'quality satisfactory' ... seems clearly enough one on which there would be room for judgment and choice ... On the other hand, the seller was at liberty to prove, if he could, that his goods were rejected *not because the quality was unsatisfactory*, but because the buyer *had found a cheaper source of supply*, and having proved rejection for that reason, the seller could take it as a breach of contract and recover his damages."

Therefore, although you guaranteed the machine to be satisfactory to the buyer, he is bound to accept and pay for it if you can prove that it would be satisfactory to a reasonable user, or that the buyer is not honest in the statement that the machine is not satisfactory.

Recent Improvements in Machine Chucks

Some of the More Important Improvements Made in the Design and Construction of Lathe and Drill Chucks to Increase their Efficiency

IN appearance and cost, the chuck may seem but a small part of a well equipped machine tool. Nevertheless, it is a vital factor, and upon its gripping power, accuracy, ease of operation, and durability depends the production efficiency of the complete machine. A worn out chuck will often cause a good machine to give very unsatisfactory service.

The outline of improvements in chucks given in this article should be of assistance in deciding when the purchase of new chuck equipment for present machines will prove a profitable investment. It should also serve as a guide in selecting the most efficient chuck equipment for new machines.

Present-day Chucks are Made of Better Materials

The hard and practically unbreakable chuck-jaw screws with which most lathe chucks are now equipped are made from specially heat-treated alloy steel instead of the less expensive machine steel previously employed for these parts. For example, one manufacturer of lathe chucks is now making chuck-jaw screws from heat-treated chrome-nickel steel.

The jaws of modern chucks are also made from carefully selected alloy steel and are heat-treated and hardened on every surface, including the threads. The jaws are ground on the steps and the body-bearing surfaces to close limits of accuracy, so that all jaws of similar size and style are interchangeable. Carefully selected and heat-treated alloy steels are also used for the scroll plates of scroll-type chucks.

Manufacturers of drill chucks are now making the bodies of their chucks with deeply casehardened surfaces. Drill chuck jaws that are far stronger than any previously produced are obtained by modern methods of heat-treating, and breakage of such jaws is claimed to be practically impossible. Even the drill chuck keys produced by one well-known manufacturer are made from stronger materials and heat-treated by up-to-date methods.

Improvements in Chuck Body and Jaw Screw Design

Practically all manufacturers have entirely redesigned the bodies of their lathe chucks, putting the metal where it will do the most good. The ribs or bearings on which the jaws ride are now being made wider and heavier. When the work-holding jaws are individually controlled by a driving screw, considerable thought has been given to determining the size, shape, and diameter of the screws.

Increasing the diameter of the screw necessitates increasing the jaw width. This, in turn, makes it necessary to cut away a corresponding amount of metal from the chuck body where it is needed for strength. With these facts in view, considerable engineering work has been done in working out the best proportions for the body, screws, and jaws of the latest type chucks. Experience seems to indicate that screws having a square thread with a coarse pitch give the most satisfactory service.

The thrust bearings provided for the jaw screws have been improved. One of the latest types of bearings adopted by a well-known manufacturer is made in two segments, which, when placed together, entirely encircle the screw. This bearing takes the thrust in both directions, is self-aligning, practically unbreakable, and permits chips from the cutting tool to pass out of the chuck easily without clogging. Also, it does not require a cored recess under the screw, which would tend to weaken the chuck body.

Self-centering Chucks of Greater Accuracy

Within the last two or three years some manufacturers have discontinued their former lines of self-centering chucks, replacing them with improved designs. These newer chucks have greater gripping power and are designed to keep the work centered accurately. One manufacturer has developed a special gear-cutting machine for forming and finishing the teeth of scroll chucks in order to obtain the greatest possible accuracy in the concentricity of the jaws.

Ball-bearing Drill Chucks

Some of the new model drill chucks, designed to have a proper balance between gripping power, wearing quality, and strength, actually have double the gripping power of previous models of the same sizes. The ball-bearing drill chucks are claimed to have from 50 to 200 per cent greater gripping power than chucks with plain bearings. The threads of a single jaw of one make of 1/2-inch size ball-bearing chuck will support a shearing stress of 10 tons.

The jaws of the ball-bearing chucks can be moved into the gripping position with a spin of the sleeve in half the time required with earlier types. This quick action is due to the coarser pitch thread now used and the application of ball bearings to eliminate friction.

When Chucks should be Replaced

From an economical point of view, there may be many reasons why a chuck should be replaced even though it appears to have had but little wear. If the jaws have become so worn that they fit loosely, they will not hold the work in a central position. If the chuck is too small or light for the work that

should be handled on the machine, a larger or stronger chuck should be used.

Often overstrain, lack of lubrication, or ordinary wear will put a chuck in such a condition that even though it still holds the work, too much time is required for the chucking operation. Using a chuck in this condition is false economy, especially if it is employed on production work.

Having the right chuck available for every job is an important factor in keeping down costs. Some jobs can be handled on a combination chuck in half the time required when a regular chuck is used. It may be well to mention here that collet chucks are now being made in much larger sizes than formerly. These collet chucks can often be used to advantage for holding work that was formerly machined on lathe centers.

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INCREASING USE OF ALLOY STEELS

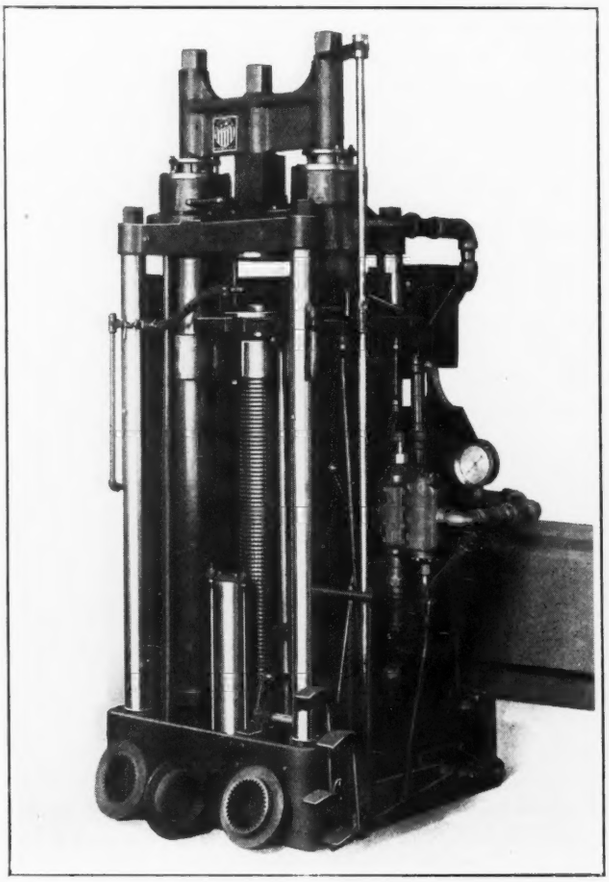
Alloy steels are being used more and more for agricultural machinery and implements. These steels have proved themselves so valuable in automobile manufacture that it is only a matter of time before they will be used for many other purposes where strength in conjunction with lightness is a valuable feature. According to F. J. Griffiths, chairman of the Central Alloy Steel Corporation, about 50 per cent of the metal parts of a modern automobile are made from alloy steels, and as a result, the average automobile is 30 per cent lighter than it would be if it were manufactured from carbon steel, although it has increased strength and durability.

However, the introduction of alloy steel has resulted in an unforeseen complication. Railroad blacksmiths and repairmen, for example, have been trained for generations in the treatment of carbon steel only. When these men are confronted by alloy steel, they do not know how it should be heat-treated. The same problem presents itself in agricultural machinery when country repair shops are depended upon to keep the machinery in repairs. Nevertheless, alloy steels are finding their way into farm machinery to an ever increasing extent. Lighter and stronger equipment will be the result.

BROACHING INTERNAL GEARS

Internal gears 6 inches in diameter and 2 inches face width, having 30 teeth, are broached at the rate of one every twenty seconds in the machine here illustrated, which was recently built by the American Broach & Machine Co., Ann Arbor, Mich. In the illustration, three of the broached gears may be seen on the floor resting against the base of the machine. One gear is completed at each pass of the broach.

The machine is of the V-50 pull type described in November, 1929, MACHINERY, page 234. It is operated by an oil-pump made by the concern, and has a capacity of fifty tons. Being of vertical design, the machine occupies little floor space.



Vertical Machine Used for Broaching Internal Tractor Gears

The broach used in this operation was ground all over, and was also manufactured by the American Broach & Machine Co. It weighs approximately 440 pounds. Because of the manner in which the broach is hung in the machine, it centers itself and there is no tendency for it to creep off center.

* * *

DREAMS COMING TRUE IN ENGINEERING

Fifteen years ago, Charles Steinmetz of the General Electric Co. wrote a magazine article entitled "You Will Think This is a Dream," in which he made many predictions as to the uses of electricity in the future. Some of these predictions have already come true.

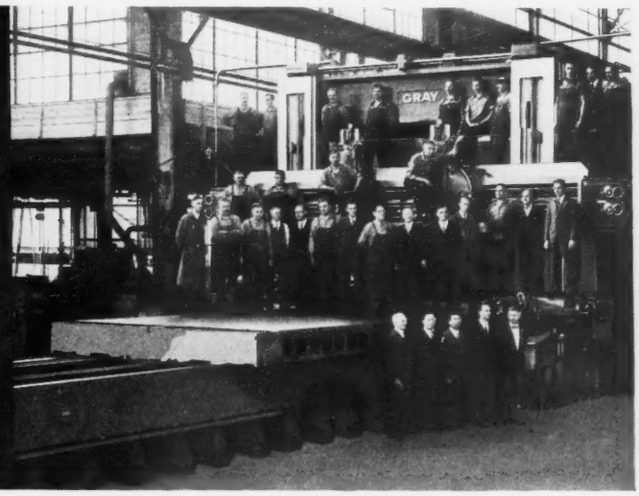
He wrote: "Millions will hear concerts in their homes." Thirteen million radio sets have been sold in the last seven years.

Mr. Steinmetz also predicted the talking movies. There are now twenty thousand theaters capable of producing talking movies. He predicted that buildings and homes would not only be heated by electricity, but also cooled by this agency. Nearly two million electric refrigerators are now in use.

He looked forward to farm electrification. Today six hundred thousand farms in the United States are supplied with electric current. He also predicted that we would have single power plants with a capacity of over 1,000,000 horsepower. While this prophecy has not been completely fulfilled, the largest power plant today is over four times as great as fifteen years ago.

New Shop Equipment

Latest Developments in Metal-working Machines, Small Tools, and Work-handling Appliances



GRAY "ULTRA-SIZE" PLANER

Work up to 12 feet wide, 10 feet high, and 30 feet long can be planed in the first of a new line of large planers recently developed by the G. A. Gray Co., 3611 Woodburn Ave., Cincinnati, Ohio. This machine was built for the Niagara Machine & Tool Works, Buffalo, N. Y. It has a weight of approximately one-half million pounds. One of the outstanding features of the machine is the universal control at the tool point, the operator having complete control of the planer while standing adjacent to the cutting tool.

Other features include a rail clamp controlled by a single button, which automatically unclamps the rail, raises or lowers it, and finally reclamps it; a triple-station, single-shift rapid-

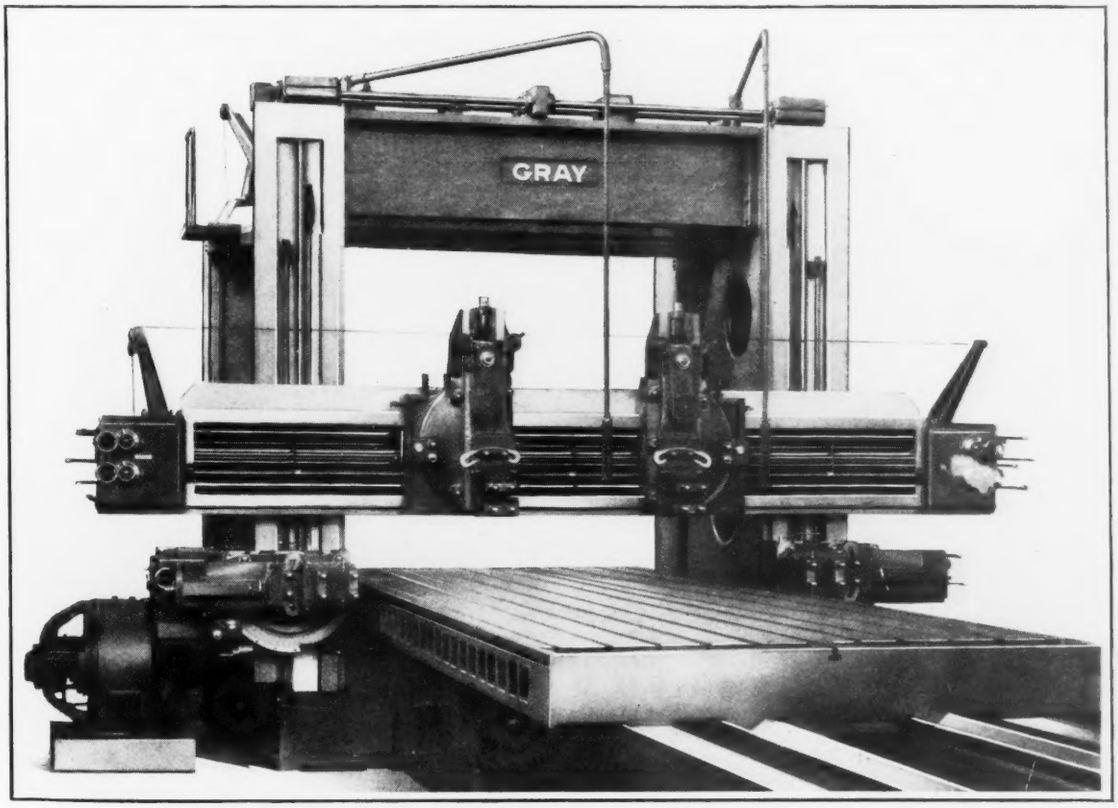


Fig. 1. Gray "Ultra-Size" Planer Designed to be Completely Controlled by One Man

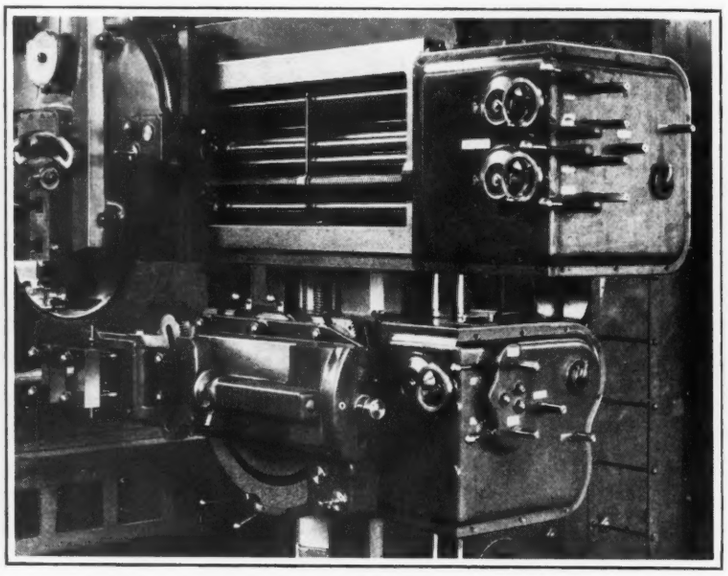


Fig. 2. View Showing the Controls on the Side-head and Rail End

traverse control for the rail-heads and side-heads; a triple-station feed control for the rail-heads and side-heads; a hand traverse of all heads in all directions obtainable at the heads; positive-feed dials which can be set from either end of the rail; an independent feed for each of the four heads; a 45-degree power angular feed of the side-head tools through slip-off gears, in addition to normal angular feeds through an inclination of the slide; self-contained automatic tool lifters for the rail-heads and side-heads; a counterbalance for the rail-head slides; a ball-bearing spring counterbalance for the rail-head saddles; a worm-gear swiveling arrangement for all harps and tool-boxes; automatic traveling supports for the rail screws and rods; abutment tool-boxes for the rail-heads and side-heads; balanced "Twin Helical" driving gears; a bed with four ways; a constant-pressure way oiling system; and a splash lubricating system for the gears and rail-end parts.

To raise the rail, the operator merely pushes a button marked "Raise" on the pendent switch. This releases the clamping motors, and the rail is then elevated automatically until the operator releases the button, at which time the rail stops instantly and is automatically reclamped. A button marked "Lower" is provided on the pendent switch for lowering the rail.

To traverse a head rapidly in any direction, the operator makes a single shift of a lever. There are three stations at which this may be done, it being possible to control each rail-head at either end of the rail and at the head itself. The operator can also traverse the cutting tool by hand in any direction from three stations. Graduated micrometer collars permit the movement of the tools to be determined in thousandths of an inch.

There are also three controls for the side-heads, one at the outer end, one on top near the inner end, and one on the bottom near the inner end. Thus, the operator has a convenient control of the side-head tool, regardless of the position of the head on the housing. The feed of any head may be engaged or disengaged at the three rapid-traverse stations by imparting a slight angular shift to a lever. The feed can be made to occur at either end of the stroke, and the amount of feed of each head can be varied independently of the other heads.

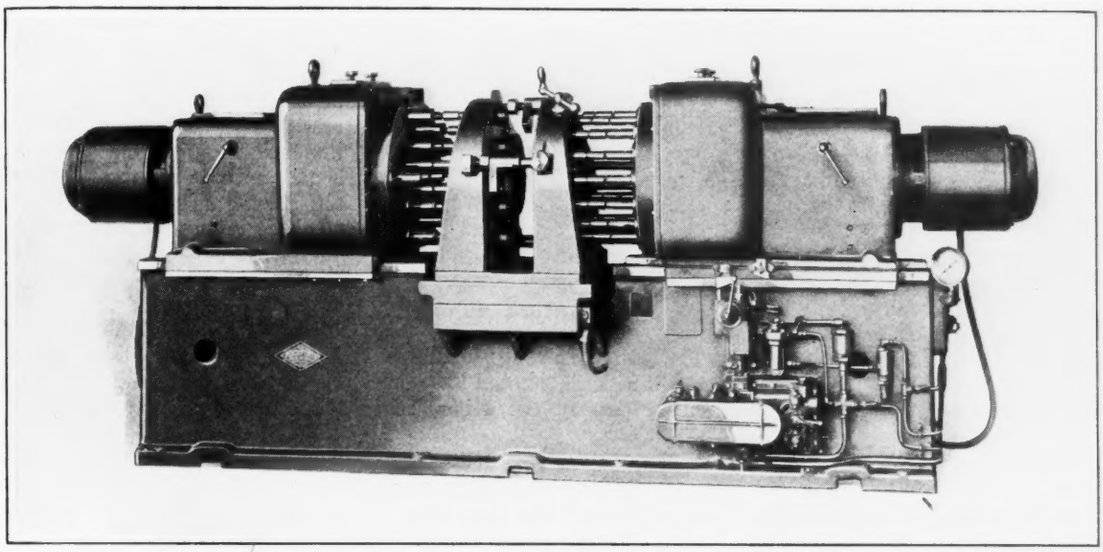
The automatic tool lifters on the heads can be engaged or disengaged at will. The lift of the tool is constant. Although the rail-heads weigh two tons each, they can be moved horizontally, or the slide moved vertically, by a slight movement of the control handles. The weight of each head is carried by compression springs and two ball-bearing rollers which run in a groove on top of the rail. This insures that the saddle will always have a snug fit in the dovetail at the bottom of the rail, and prevents upward movement of the head as the cutting tool reaches the work. The weight of the slide, tool-box, apron, and cutting tool is counterbalanced separately. Each harp is swiveled by rotating a crank on a gear-box. The tool-box is swiveled by a ratchet crank on a worm meshing with a sector machined in the top of the box.

A steel camber beam is mounted on top of the rail to compensate for the weight of the heads. This beam is adjustable, so that the tools will cut straight as they travel along the rail. The traveling supports prevent the lead-screws and shafts on the rail from sagging. The supports automatically move into the correct position as the heads are fed or traversed.

Helical driving gears are used from the first pinion to the bull gear and to the table rack, with a view to insuring smooth motion of the table. The center section of the bed, which contains the gear train and to which the housings are bolted, is a massive casting 4 feet deep, weighing more than 36 tons. Three rows of leveling screws support the bed for its entire length.

The table weighs approximately 60 tons and slides on two vee and two flat ways. The constant-pressure oiling system insures distribution of oil to all bearing surfaces even when operating at short strokes. Wherever practicable, gears, shafts, clutches, etc., are supported by anti-friction bearings, there being a total of 407 ball and roller bearings in the machine.

This planer is designed to operate at any cutting and return speeds that may be necessary to



Rockford Machine Designed for Drilling and Tapping Thirty-six Holes in Two Operations

meet future developments in tungsten-carbide or other superhard alloys. The particular planer illustrated is equipped with a 75-horsepower General Electric reversing motor which operates at a speed of from 200 to 1200 revolutions per minute. Table cutting speeds of from 20 to 120 feet per minute and variable return speeds covering the same range are available.

ROCKFORD HORIZONTAL DRILLING AND TAPPING MACHINE

The functions of a multiple-spindle drilling and tapping machine recently built by the Rockford Drilling Machine Co., 209 Catherine St., Rockford, Ill., are controlled hydraulically through the use of an Oilgear pump. Two advantages claimed for this control are that clean cut threads are obtainable and that the danger of tap breakage is reduced to a minimum.

The particular machine shown has nineteen spindles at one end and seventeen spindles at the other end. After all holes have been drilled simultaneously in one batch of parts, the machine is set for tapping, and the same parts are run through the machine a second time. The tapped holes vary in size.

Ball-bearing electric motors transmit power direct to each drive-head proper. The power is then delivered through reduction gears to the main drive in the front compartment of the head, which accommodates the spindle unit. Revolving parts in the drive-heads are mounted in Timken tapered roller bearings and run in a bath of oil. Drilling or tapping speeds are secured by moving a clutch lever on each head.

The spindles are built into separate units which fit into the front compartment of the drive-heads proper. The main drives of these heads connect with the main drive spindles of the spindle units. This construction permits the interchanging of spindle units having different numbers of spindles or having the spindles located on other centers.

Both heads are coupled together through a rack and pinions, so that they work in unison. When the machine is set for drilling, both heads traverse forward rapidly to the point where the drills are about to start working. Then the heads slow down automatically to the proper feeding rate, drill to the predetermined point, and finally traverse rapidly to the starting position, where they stop, ready for the next cycle.

When the machine is arranged for tapping, the automatic features are much the same, with the exception that the spindles revolve in the reverse direction during the return movement of the heads. If a hole to be tapped should not be drilled the required distance or should be obstructed in some manner, the sentiveness of the machine is such that the resistance encountered by the tap would be sufficient to trip the head into the reverse feed and the spindles into reverse rotation. This machine can be furnished in several sizes.

FITCHBURG FIVE-STATION DRILLING MACHINE

The four-spindle head five-station drilling machine shown in the illustration was developed recently by the Fitchburg Grinding Machine Corporation, Fitchburg, Mass., for performing a number of operations on a single hole. The particular set-up shown is for machining the 15/16-inch distributor hole on a Ford cylinder block. The operations consist of drilling half way at the first station, finish-drilling at the second station, rough-reaming and countersinking at the third, and finish-reaming at the

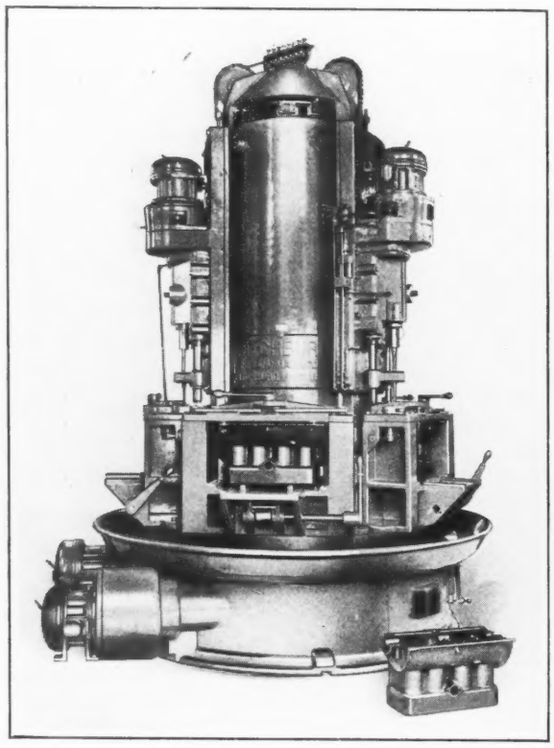
fourth station. Unloading and loading is accomplished at the fifth station.

The cylinder block is clamped in the fixture by means of two levers. The table is then automatically indexed to bring the work in each fixture to the succeeding station. Each indexing cycle requires thirty-six seconds, and gives the operator time to unload and load the fixture between indexing movements. Consequently, the production rate on this particular job is thirty-six seconds per piece.

Individual motors are applied to each drive. The rotary table is indexed by a motor through a worm drive having an electric brake control. The down feed and return movements of the drilling heads are provided by a rotating barrel cam in the column, driven by a two-speed motor which furnishes one speed for the feed and a different speed for the rapid approach and return. The cam paths are cut to give the proper feeds for the kind of work to be handled.

Each drill head contains an oil reservoir and is flood lubricated on the down stroke by a piston pump actuated by the movement of the head. The remainder of the machine is lubricated from a reservoir in the base, the oil being pumped to the top of the column and distributed from that point by an adjustable sight-feed head.

The fixtures attached to the rotary table are designed for the particular work to be done. Two spring-actuated locating plungers in the drill heads fit bushings in each fixture and keep the heads and the fixtures in proper alignment. The weight of this machine is approximately 40,000 pounds.



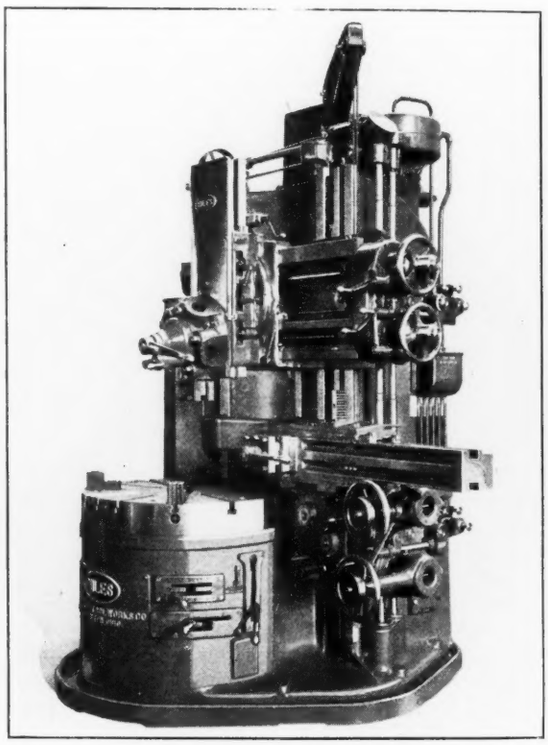
Fitchburg Five-station Drilling Machine

NILES SIDE-HEAD BORING MILL

The 42-50 inch side-head boring mill here illustrated has been brought out by the Niles Tool Works Co., Hamilton, Ohio, to meet the demand for a larger machine of the same design as the 36-44 inch mill built by this concern. The machine has a heavy one-piece base and column. The cross-rail has a three-track bearing surface with a narrow guide for the vertical head saddle. The screw that produces the longitudinal motion is placed between the two lower tracks to prevent the saddle from cramping under heavy feeds.

The vertical head slides in bearings of the square-lock type. Taper gibs facilitate adjustments for wear and the maintenance of accurate alignment between the turret and the table spindle. The side head is an entirely independent unit, attached directly to the column. There are but two movable joints between the cutting tool and the column, one for vertical and the other for horizontal travel. The side-head casting extends across the column and has three bearings, which are also of the square-lock type with taper gib adjustments.

Both heads have rapid traverse movements of 120 inches per minute, irrespective of the feeds



Niles Boring Mill with Vertical and Side Heads

or table speeds. Sixteen feeds are provided for both heads, ranging from 0.004 to 0.750 inch per revolution of the table. Both heads are fitted with large micrometer dials, as well as graduated scales and observation stops. The feeds and rapid traverse for the rail-head and side-head are entirely independent of each other.

The feed units are of the selective sliding-gear type operated by safety pull-pins. The table speed change-gear box is assembled as a separate unit in the bed, and provides twelve speed changes ranging from 3.2 to 70 revolutions per minute.

Spiral bevel gears are used for the table drive. The pinion is supported in roller bearings at each end to take the thrust developed by the gears. A multiple-disk clutch engages the table feed. A cone brake incorporated in the clutch stops the table instantly when the clutch is released.

The controls are grouped and centralized to facilitate operation, and are of the interlocking type. Thread-cutting attachments for either the vertical- or side-head, a taper or forming attachment for the side-head, and a special cutting-fluid system can be furnished as additional equipment when desired.

MOLINE PIPE MACHINE

A special machine was recently constructed by the Moline Tool Co., Moline, Ill., for reaming, hollow-milling, tapping, and threading the bell and spigot ends of long sections of cast-iron gas pipe. After the operation, these pipe sections may be screwed together instead of being calked, as in the old manner. Pipe 5, 7, and 9 inches in diameter and from 6 to 16 1/2 feet long can be handled.

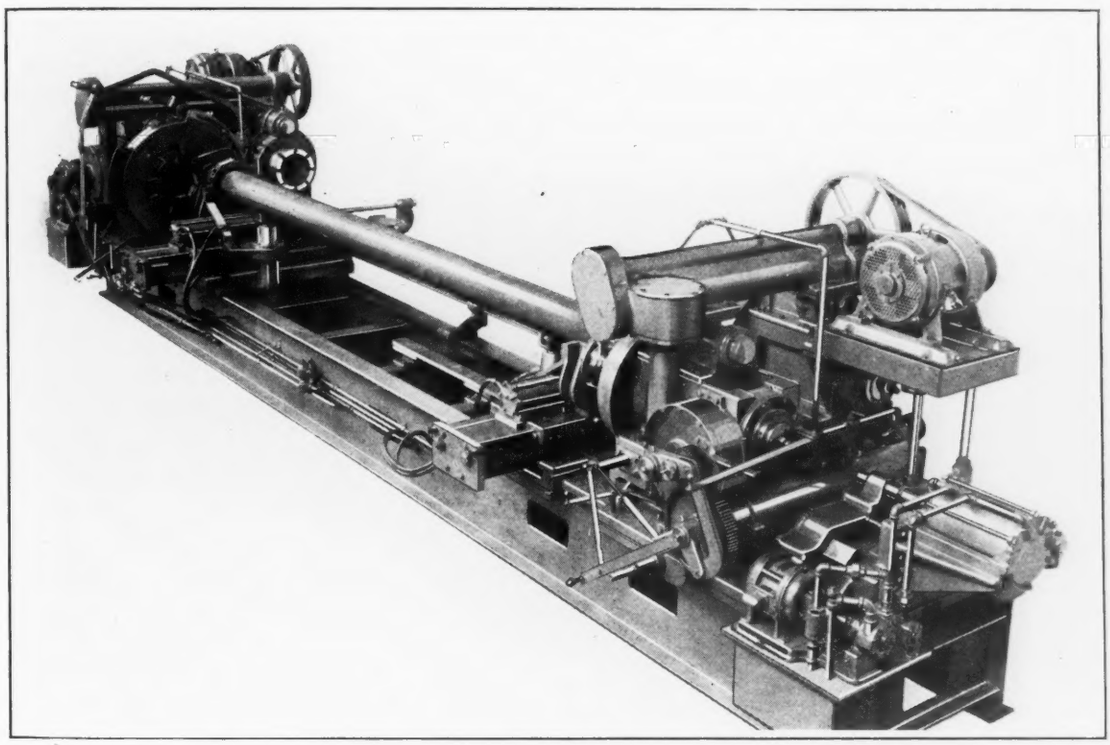


Fig. 1. Moline Machine which Hollow-mills and Threads One End of Cast-iron Pipe, and at the Same Time Reams and Taps the Other End

As will be seen from Fig. 1, the bed of the machine is built up of structural steel. It consists of two 20-inch H-beams, 28 1/2 feet long, which are spaced and tied together by short I-beams, welded in position. Brackets and bearings were bolted to this structure before the entire unit was machined. The upper flanges of the beams were planed on top to give a finished surface on which the remainder of the machine was built.

There are two saddles on the structural steel bed that carry the tool-spindle units. The left-hand saddle is located in a permanent position, whereas the right-hand saddle is adjustable to suit different lengths of pipe. The spindle units are traversed by oil-pump units at each end of the bed to move the tools quickly to the work, and they are given a slow feed through gearing for the actual cutting. Each spindle unit is provided with its own motor, as is also true of each quick traverse unit.

Between the two spindle units are cross-heads which carry the

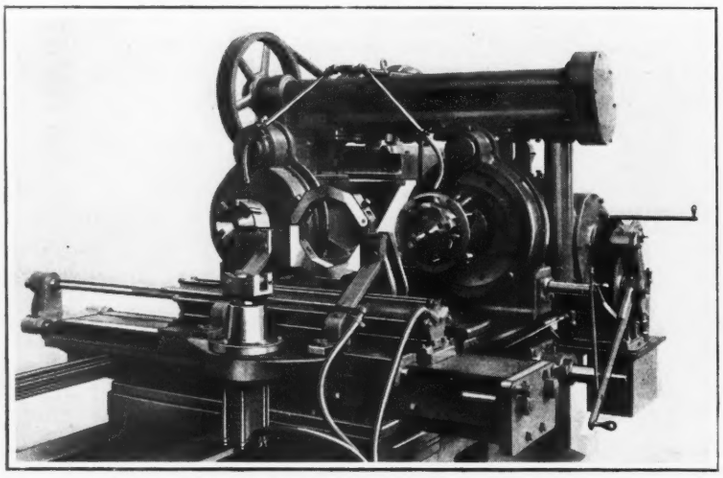


Fig. 2. Right-hand Head with its Reaming and Tapping Spindles

work-fixture, the pipe being held in a "cat head." The traverse of the cross-heads is controlled by air. In operation, two vertical cylinders are raised by means of an air valve on the front of the left-hand cross-head. Then the pipe is lifted into position by a crane or conveyor and dropped into V-blocks on the ends of pistons. The pipe is next lowered into the cat head and clamped.

Besides the valve that controls the pistons of the vertical cylinders, there is a valve that governs the horizontal movement of the pipe after it is in the fixture. The cross-heads are brought against a positive stop to locate the pipe in line with the two rear spindles of both units, and then a hollow-milling operation is performed on one end of the pipe while the other end is bored. Upon the completion of these cuts, the cross-heads are moved forward in line with the two front spindles, and one end of the pipe is threaded externally while the other end is tapped.

AUTOMATIC CRANKPIN-TURNING AND CHEEK-FACING LATHE

An automatic crankpin-turning and cheek-facing lathe capable of withstanding the high speeds and increased feeds made possible by the improved cutting tools has been brought out by the Crankshaft Machine Co., 320 N. Jackson St., Jackson, Mich. The machine weighs approximately 44,000 pounds, and is made in three lengths to accommodate four-, six-, and eight-cylinder automobile crankshafts.

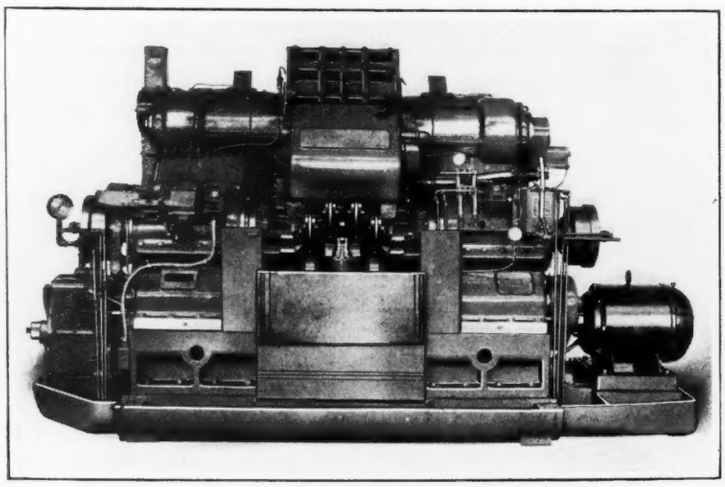
The work is gripped at each end in chucks operated by 12-inch air cylinders. These chucks are mounted on spindles to which power is transmitted by a 25-horsepower motor which also drives other rotating parts.

Eccentric or master crankshafts drive the upper and lower tool arms in synchronism with the work. The tools for rough-facing the cheeks and rough-turning the pins and pin walls are mounted on the upper tool arms, while the tools for finishing the cheeks and pin walls are mounted on the lower tool arms. An Oilgear hydraulic feed is employed for advancing the tools.

The machine is controlled by two push-button stations and three levers. A crankshaft can be easily put in place when the machine is in the loading position with the chucks and steadyrest open. The chuck and steadyrest latches are then locked by the movement of an air-cylinder control lever. The driving shoes in the chucks are next operated by the movement of another air-cylinder control lever, after which the feed-lever is moved, and the starting button pressed.

The machine then automatically faces the cheek and pin walls and turns the pins of the crankshaft to the desired diameter, returns the carriages, and stops the spindles in the loading position. The two air-cylinder control levers are now moved, causing the chuck and steadyrest latches to open, after which the work is removed and the cycle of operations repeated.

The time required is 5 seconds for the rapid traverse; 7 seconds for turning the cheeks with a feed of 1/32 to 1/16 inch per revolution and turning the pins with a feed of 0.005 to 0.010 inch per revolution and for the return feed; and 10 seconds for reloading. The speed and feed will vary with the hardness of



Automatic Crankpin-turning and Cheek-facing Lathe Built by the Crankshaft Machine Co.

INDEXING MOVEMENTS FOR ANGLES—1

With the ordinary indexing head 40 turns of the index-crank are required for one revolution of the work. One turn of the index-crank equals 9 degrees. Two holes in the 18-hole circle, 3 holes in the 27-hole circle, and 6 holes in the 54-hole circle correspond to one degree. This and nine succeeding Data Sheets cover all the angles obtainable from 0 to 9 degrees with the regular indexing heads of the machines listed.

Angles greater than 9 degrees are obtained by indexing one complete revolution and whatever additional amount may be required to give the desired angle, the additional indexing movement being determined from the Data Sheets. Thus, the angle 9 degrees 10 minutes is obtained by making one revolution of the index-crank and one hole in the 54-hole circle.

The Brown & Sharpe, Becker, Hendey, Kearney & Trecker, and Rockford indexing heads have the same number of holes in the index circles. The index circles of the Cincinnati and LeBlond machines differ from these, and are therefore given a separate column. The LeBlond dividing head has the same index circles as the Cincinnati, except that the LeBlond does not have the 24-, 25-, 28-, and 30-hole circles, but has, instead, 36-, 48-, and 56-hole circles. Movements in the 24- and 28-hole circles of the Cincinnati index-head may be duplicated on the LeBlond index-head by taking double the number of holes in the 48-hole and 56-hole circles, respectively.

ANGLES OBTAINED WITH INDEXING HEADS OF VARIOUS MACHINES

Angle in Minutes and Seconds		B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Minutes and Seconds		B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
8	10.9	..	..	1	66	12	51.4	..	..	1	42
8	42.5	..	..	1	62	13	10.2	1	41	1	41
9	9.1	..	..	1	59	13	50.7	1	39	1	39
9	18.6	..	..	1	58	14	12.6	..	..	1	38
9	28.4	..	..	1	57	14	35.6	1	37	1	37
10	0.0	..	..	1	54	15	52.9	..	..	1	34
10	11.3	..	..	1	53	16	21.8	1	33	2	66
10	35.3	..	..	1	51	17	25.1	1	31	2	62
11	1.2	1	49	1	49	18	0.0	..	..	1	30
11	29.3	1	47	1	47	18	18.3	..	..	2	59
11	44.3	..	..	1	46	18	37.2	1	29	2	58
12	33.4	1	43	1	43	18	56.8	..	..	2	57

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INDEXING MOVEMENTS FOR ANGLES—2

Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
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0	45	45.7	..	..	5	59	1	13	13.2	..	..	8	59

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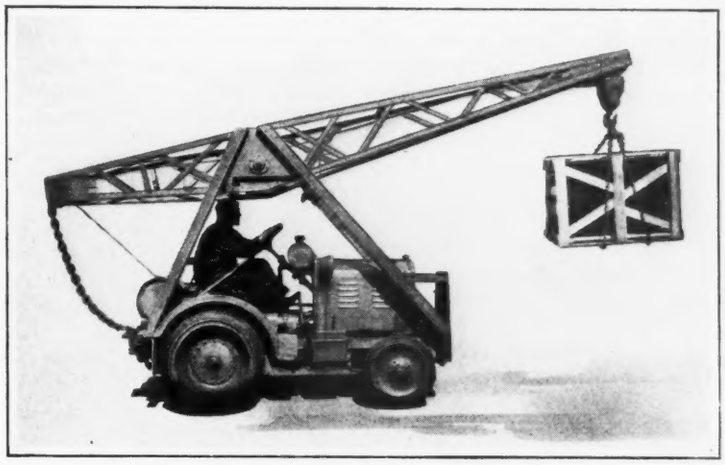
the work. When desired, the machine may be operated by hand, it being possible to stop the feed at any part of the cycle and then stop the spindles in any desired position.

Each of the work-spindles is carried in two Timken tapered roller bearings. The upper eccentric or upper master crankshaft is made in three sections. Each of the two outer sections is carried on two Timken tapered roller bearings, while the center section is mounted on three ball bearings. The lower eccentric or lower master crankshaft is also made in three sections, each of which is carried on ball bearings. By making these shafts in three sections, it is possible to change all the special parts required for machining different crankshafts without disturbing the timing of the machine.



"Clarktor" Tractor Crane of Variable Height

"CLARKTOR" VARIABLE-HEIGHT TRACTOR CRANE

A variable-height tractor crane has been brought out by the Clark Tructractor Co., Battle Creek, Mich., for such work as placing heavy castings and forgings on drilling machines, lathes, and other machine tools, handling heavy parts and machines in storage, and handling heavy crates, boxes, and other loads lifted by chains or hooks.

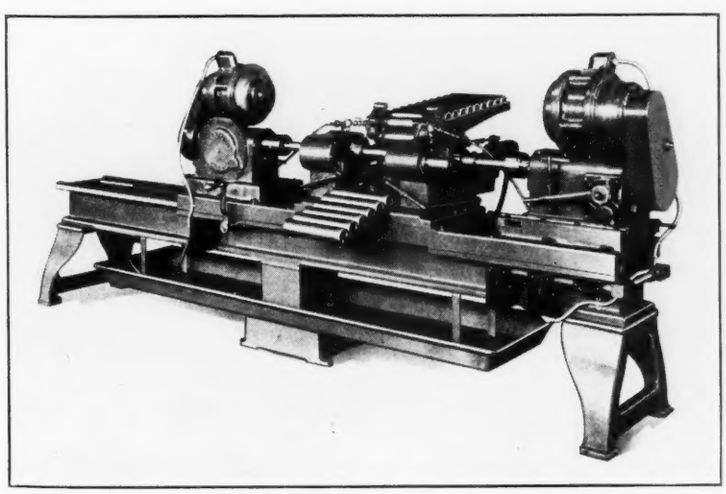
The crane has a capacity for lifting 2000 pounds to a height of 13 feet, and yet when the boom is horizontal, the entire equipment has an over-all height of but 7 feet 10 inches, permitting it to enter plant and warehouse doors. The crane is mounted on a Tructractor which has a turning radius of 108 inches. The equipment includes a standard truck transmission, Clark truck axle, and multiple-disk clutch, and is provided with a self-starter, generator, battery, and head and tail lights.

BRADFORD DOUBLE-END REAMING AND CHAMFERING MACHINE

The Bradford Machine Tool Co., 657 Evans St., Cincinnati, Ohio, has recently developed a double-end machine for reaming and chamfering the ends of rollers used in the construction of conveyors. These rollers have an outside diameter of 2 1/2 or 3 inches, and vary in length from 6 to 48 inches. All sizes are reamed to 1.580 inches and have a 1/16-inch chamfer machined on them.

The machine consists of two Bradford automatic single-spindle drill heads, arranged to operate in conjunction with an automatic magazine fixture. Half of the magazine fixture and one head are mounted in a fixed position on the bed, while the other half of the fixture and the other head are adjustable to accommodate various lengths of rolls. The machine is fully automatic. Electrical control of the motors that operate the two drill units and of the motor that controls the coolant supply system is obtained through one push-button.

In operating this machine, the attendant throws the feeding mechanism of the master head into engagement by lifting the lever on the side of the right-hand unit. A cam on this head actuates an automatic control valve to open the air supply line. Compressed air then passes first to cylinders which control the transfer fingers of the magazine, and as these fingers are advanced, they carry a roller into the working position.



Bradford Two-head Machine Arranged for Reaming and Chamfering Conveyor Rolls

After the pistons that operate the transfer fingers reach the end of their stroke, the air supply is by-passed to two cylinders at the front of the fixture. These cylinders operate bell-mouthed housings which centralize and clamp the work in position. During the period that the magazine fixture is operating, air is delivered to a tripping unit attached to the feed-lever of the second drill head. As the clamping of the part is completed, the spindles of the drilling units advance at the rapid traverse rate, slow down to a feed of 0.040 inch per revolution for the reaming operation, and then slow down still further to 0.005 inch per revolution for the chamfering operation.

Finally, both spindles return at the rapid traverse rate to the starting point, and when the tools have been withdrawn from the work, the cam on the master head again actuates the automatic control valve and cuts off the air supply. The transfer fingers are carried back to the starting point by a spring return, and then the bell-mouthed housings are returned to their neutral position and the finished part is ejected from the fixture. The operating cycle of the machine is six seconds.

AMERICAN FULL-AUTOMATIC BROACHING MACHINES

Broaching machines that are believed to be the first fully automatic machines of this type have recently been built by the American Broach & Machine Co., Ann Arbor, Mich. Two of these machines are shown in the accompanying illustrations. No operator is required for the V-50 machine shown in Figs. 1 and 2, which is used for broaching bushings from seamless steel tubing. These bushings have a hole approximately 1 5/16 inches in diameter and are 5 1/2 inches long. About 0.080 inch of stock on the diameter is removed.

The pieces are fed from a cutting-off machine to a tube on the front of the broaching machine which serves as a magazine. Below this tube, there is an automatic slide controlled by a hydraulic cylinder through the action of a valve on the left-hand side of the machine, as illustrated in Fig. 1. When the slide is in its outer position, where it receives the work, as shown in the illustration, the broach shank is in its lower position.

In operation, as the slide moves inward to carry the work into position, the broach is raised by means of a hydraulic cylinder in the base and connected to an automatic pull-head. This head immediately starts on its upward or cutting stroke, and continues until the broach has

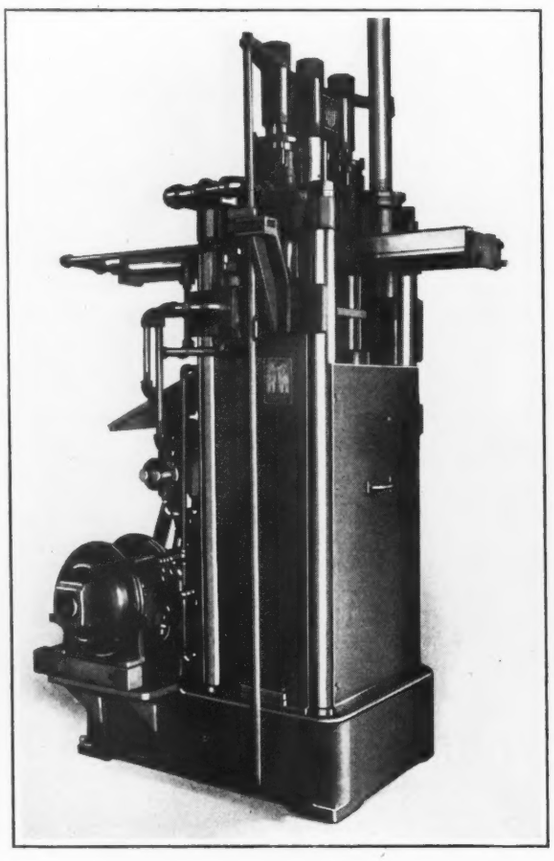


Fig. 1. American Broaching Machine which Does Not Require an Operator

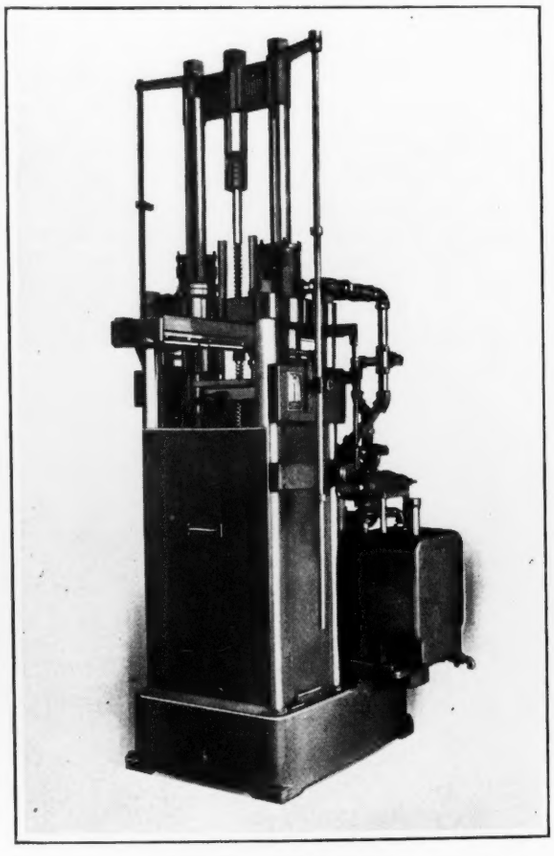


Fig. 2. View Showing the Broach Approaching the End of the Upward Stroke

passed completely through the work, after which the work slides down the chute seen at the rear of the machine in Fig. 1. In the meantime, when the broach has reached the approximate position shown in Fig. 2, the slide is returned to receive another piece.

After each piece of work has been finished, the rams immediately return to the starting position and the broach is automatically released into the lower broach receptacle. Each cycle of the machine requires twelve seconds. It will be noted that there are no levers whatever on this machine, the equipment being started and stopped by means of an electric switch that controls the motor.

Another advantage of this machine besides not requiring an operator is the fact that the broach and work tend to center themselves. Production has been doubled over the output previously obtained with a horizontal machine in which the operator had to handle the broach and parts at each stroke. The floor space occupied is less than one-fifth of that formerly required.

Fig. 3 shows a V-18 full-automatic machine tooled up for broaching four bevel differential pinions at one time. The hole broached is 7/8 inch in diameter, and approximately 0.020 inch of stock is removed on the diameter. The magazine of this machine can be fed manually, or by means of a conveyor or hopper. Four parts are broached every eight seconds, which gives a production of thirty pieces per minute.

This machine works on the same principle as the V-50 machine, but is a smaller size. It has been built in several sizes for different classes of work. In one shop, a machine of this type broaches two keyways in the tapered hole of a malleable-iron casting. The keyways are approximately 100 degrees apart in a hole that measures 3/4 inch at the small end. The keyways are 3/16 inch wide, and the part is 1 1/2 inches long. Three pieces are broached at a time. It is mentioned that this full automatic machine has replaced eight horizontal machines.

BLISS LONG-STROKE REDUCING PRESS

A press that has a stroke of 36 inches and operates at the rate of eighteen strokes per minute has been developed by the E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y., for redrawing long brass, copper, or aluminum shells at high speeds. The drawing speed is 170 feet per minute at eighteen strokes per minute, which compares favorably with the best modern practice in drawing brass in crank presses.

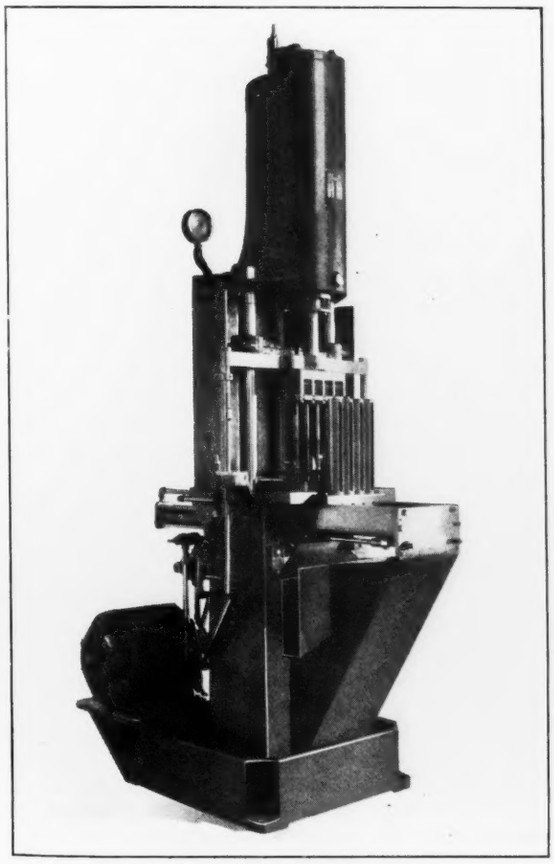
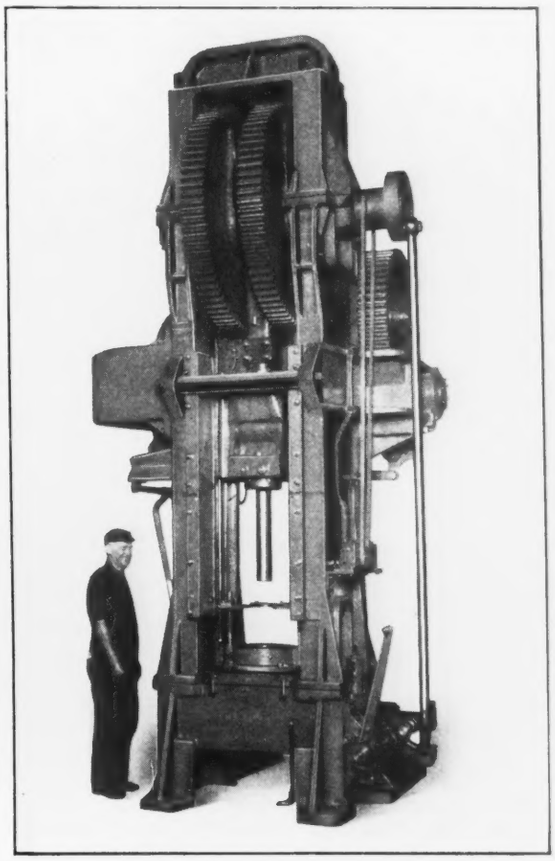


Fig. 3. Full-automatic Machine which Broaches Four Pinions at a Time



Bliss 36-inch Stroke Press which Operates at Eighteen Strokes per Minute

Twisting moment of the crankshaft is eliminated by applying the driving power at the point where the cheeks would be on a regular crankshaft. In place of the cheeks there are two large steel gears connected by a crankpin that is 18 inches from the center line of the gears. These gears are force fits on journals which rotate in long bronze-bushed bearings at the points where crank bearings would ordinarily be mounted. A solid one-piece double pinion drives the twin gears from a back-shaft. For smooth engagement, the two units of the gear train are out of step by one-half of a tooth pitch.

The press is of the built-up type with shrunk-in tie-rods. It is equipped with a full automatic friction clutch having both a foot-treadle and hand-lever control so that it can be operated by hand when setting and testing dies. The slide can be stopped or started at any point of the stroke independently of the full automatic mechanism.

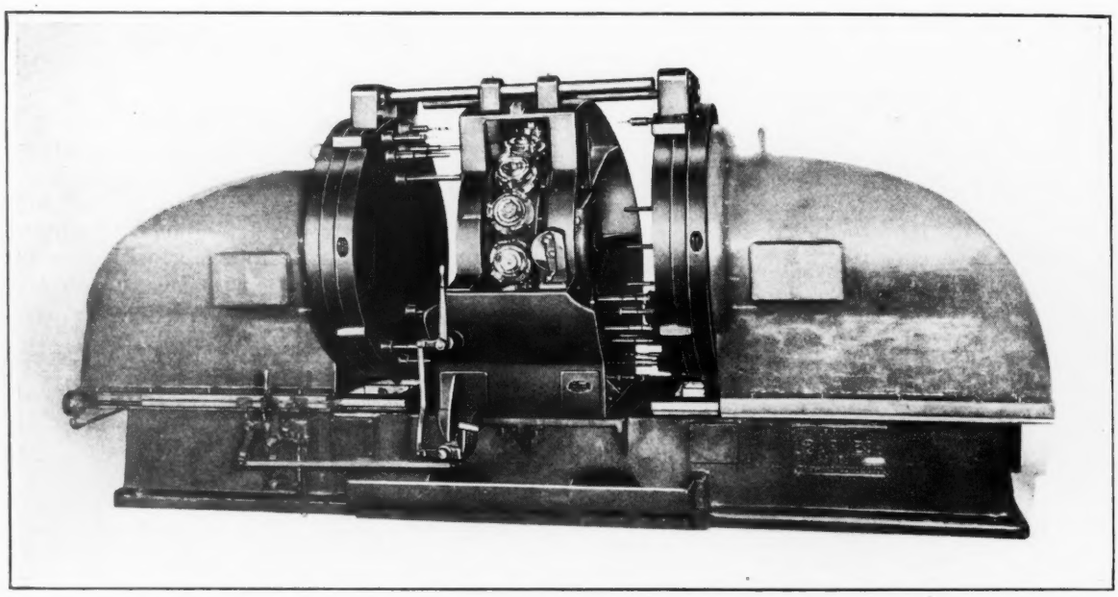
There is a mechanical force-feed lubricator with separate piping to all bearing surfaces, fourteen leads carrying oil from the main reservoir. A smaller mechanical lubricator is mounted directly on the slide for the crankpin and wrist-pin bearings. A large flywheel, 56 inches in diameter by 9 inches face width, minimizes the horsepower required to keep the flywheel up to speed. The weight of this press is about 41,000 pounds.

HORIZONTAL DRILLING MACHINE WITH SPECIAL HEADS AND FIXTURE

Thirteen holes unevenly distributed around the periphery of a drop-forged steel part are drilled and five of them counterbored in the multiple-spindle two-head machine shown in the illustration. Not only are the holes unevenly distributed, but their depth and size vary also. The work pieces are held in stations of a trunnion fixture which indexes 22 degrees for each successive step. With each indexing of the trunnions, the parts themselves are also indexed 12 degrees on their axes. Owing to the weight of the trunnion fixture, it is indexed by a crank, worm, and worm-wheel instead of by hand in the usual way. Both special drilling heads and the trunnion fixture were built by the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich., while the remainder of the machine was constructed by the W. F. & John Barnes Co., Rockford, Ill.

True alignment between the rotating fixture and the drills is insured by hardened and ground guide bars which enter bushings in the bushing plate and fixture. There is one guide bar for each working station to insure individual alignment for the machining of each hole. No time is lost in loading, as new parts are placed in the fixture while other parts are being machined.

Each of the large multiple drilling heads is of full ball-bearing design and is direct motor-driven. The heads are mounted on slides that are actuated hydraulically. The heads are approximately 6 feet in diameter. They are held in alignment by means of the two hardened and ground bars at the top of the equipment which enter bushings in the multiple heads. There is a convenient hand control for starting and stopping the feed of this machine, and an emergency foot-stop is provided.



Horizontal Drilling Machine Equipped with Trunnion Fixture Having Work Stations that Index on their Axes as the Fixture Indexes on the Trunnions

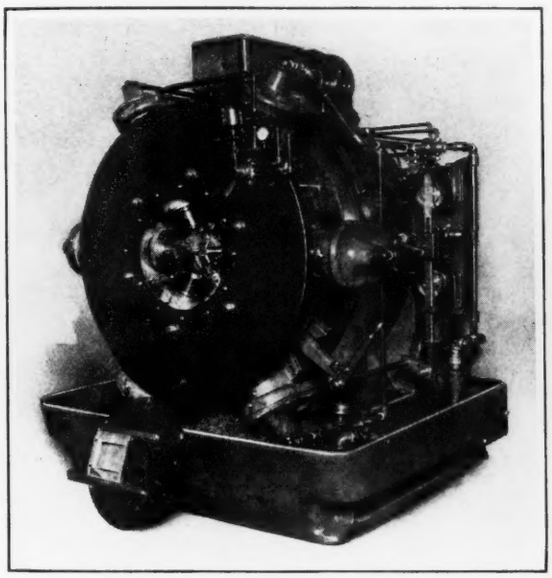
REED-PRENTICE MULTIPLE TURNING MACHINE

A multiple type of machine which is designed primarily for rough- and finish-turning three-way differential spiders, but which can also be arranged for machining four-way spiders or similar work, is shown in the illustration. This machine is a recent development of the Reed-Prentice Corporation, Worcester, Mass. The feed and indexing mechanisms are operated hydraulically by means of a standard Oilgear pump, independently of the main drive. The latter is obtained through a 15-horsepower motor running at 1200 revolutions per minute. All six tool-spindles function simultaneously.

In operation, the work piece is set in the special jaws of a Logan air chuck, after which the operator closes the jaws by turning the air valve located conveniently on the upper right-hand side of the machine. When the chuck has been closed, the lever on the lower right-hand side of the machine is manipulated to throw the Oilgear feed mechanism into operation. There is an interlocking arrangement between the air chuck and the Oilgear mechanism which prevents starting the feed until the chuck has closed.

First, three spindles are operated at a rapid traverse rate, and then the rough-turning feed is automatically thrown in. When the rough-turning has been completed, the rapid traverse again operates, withdrawing these three spindles. Next, the three finishing spindles are rapidly traversed to the work, the turning feed is engaged and, upon the completion of the cut, these spindles are rapidly returned to the starting position. The feed is automatically stopped at the end of the cycle.

Between the roughing and the finishing operations, the air chuck is indexed automatically by the Oilgear mechanism from the roughing to the finishing position. Thus the machine is semi-automatic, it being necessary only for the operator to load and unload the work. Cutting compound is fed directly to the tools and work. Exclusive of the motor, the total weight of the machine is 8150 pounds.



Reed-Prentice Machine for Turning Three-way Differential Spiders

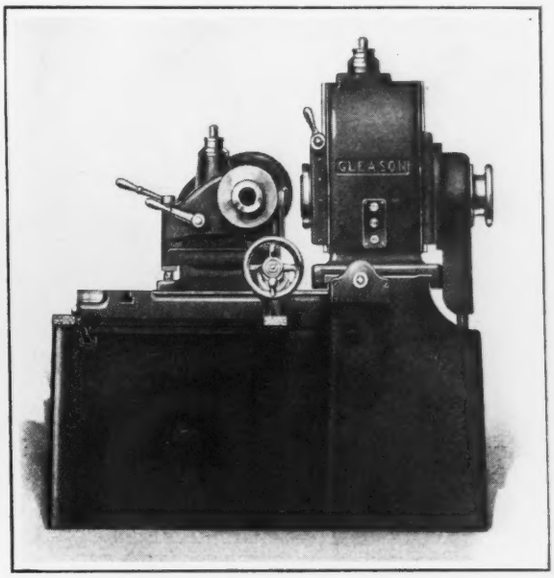


Fig. 1. Gleason Testing Machine for Various Types of Gears

GLEASON UNIVERSAL GEAR TESTING MACHINE

Straight and spiral bevel gears with any shaft angle, and hypoid, helical (for parallel or angular shaft drives) internal, herringbone, and spur gears can all be tested on a universal machine recently brought out by the Gleason Works, 1000 University Ave., Rochester, N. Y. This machine has a capacity for gears up to 13 inches outside diameter. Gears are tested by running them together with or without a load. Loads are applied manually by means of a brake that operates on the driven spindle. The adjustments of the machine may be used not only for setting it up but also for estimating the changes required in the settings of the cutting machine to give the desired tooth-bearing for correct mounting of the gears.

The driver or pinion spindle can be operated in either direction. It is mounted in a head which can be adjusted vertically on the column to obtain the required offset of the pinion from the gear center. Adjustments are made through the lead-screw provided with a dial graduated to 0.001 inch. The column can be adjusted horizontally on the frame for testing angular gears having a long cone distance.

There are three adjustments for the gear head. This head is mounted on a slide which can be adjusted horizontally to suit the

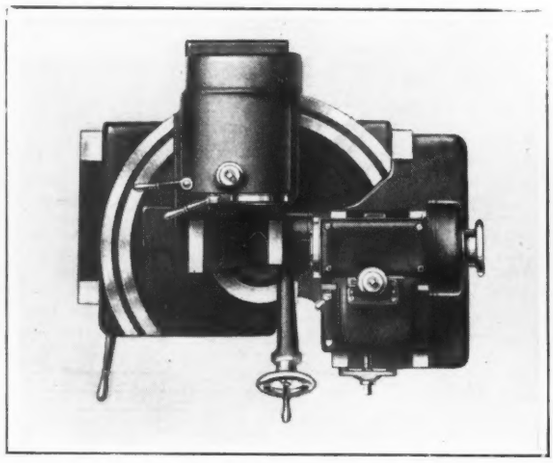
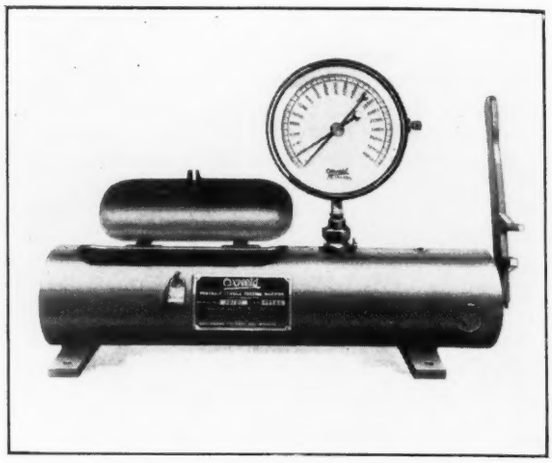


Fig. 2. Top View of the Gleason Universal Gear Testing Machine



Oxweld Portable Machine for Testing Welds in the Shop or Field

mounting distance of the gear. The slide swivels on a base to permit angular settings from 0 to 180 degrees. This base can be adjusted horizontally on the frame for changing the mounting distance of the pinion. The angular settings can be made within an accuracy of twenty seconds, while the horizontal adjustments are made by means of lead-screws equipped with dials having 0.001-inch graduations.

A three-horsepower four-speed motor equipped with a reverse control is employed for driving the pinion spindle through a double belt. Two pulleys of different sizes give eight spindle speeds from 400 to 1500 revolutions per minute. Standard equipment includes an over-arm support for the drive head and gages. The net weight of this machine is about 3500 pounds.

GENERAL ELECTRIC REVERSING MOTOR

A line of single-phase repulsion induction motors, known as the Type SCA, which are designed for frequent reversal, have been brought out by the General Electric Co., Schenectady, N. Y. These motors have a wide field of application, of which machine tools, garage equipment, and door openers are typical. The motors have the same appearance as this company's Type SCR general-purpose, single-phase motors with which they are mechanically interchangeable in corresponding sizes.

The available ratings range from 3/4 to 5 horsepower at 1800 revolutions per minute, and from 1/2 to 2 horsepower at 1200 revolutions per minute. The starting torque is high, ranging from 225 to 275 per cent of the normal full-load running torque, depending on the rating. The control consists of a full-voltage three-pole reversing switch, which may be either manually or magnetically operated.

OXWELD PORTABLE MACHINE FOR TESTING WELDS

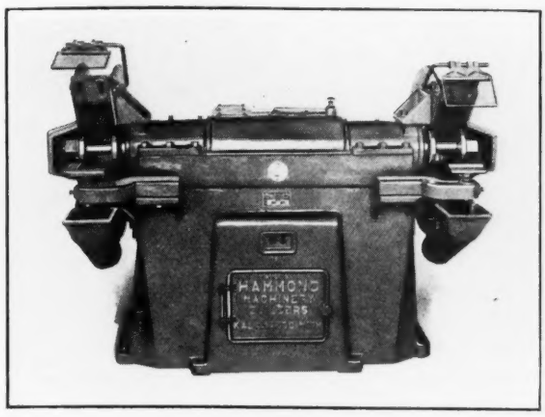
A portable tensile testing machine designed to facilitate the testing of welds in the field or shop has been placed on the market by the Oxweld Acetylene Co., 30 E. 42nd St., New York City. The machine is a self-contained totally enclosed unit. It consists of a tubular compression member with a set of gripping jaws in the head and a second set of gripping jaws connected with a piston that is operated by hydraulic pressure. This pressure is obtained from a pump operated by the hand-lever shown. The work is held between the two sets of jaws. A set of conical blocks has also been constructed to fit into the machine head in place of the jaws so that standard 1/2-inch diameter round specimens may be tested, if desired. The load is measured directly in pounds per square inch by a gage actuated by the pressure in the cylinder.

This machine makes it possible to make a tensile test immediately after welding. It also facilitates making periodic check tests of the operators, and in many cases provides a ready means for testing sections cut at random from the completed work.

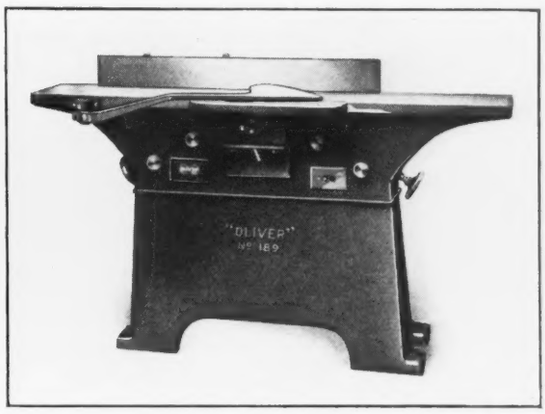
HAMMOND SELECT-O-SPEED GRINDER

To provide the high operating efficiency demanded by modern shops in the snagging and rough-grinding of such work as steel and malleable iron castings, the Hammond Machinery Builders, Inc., Kalamazoo, Mich., have developed the Select-O-Speed grinder here illustrated. A combination herringbone gear and multi-vee belt drive designed to afford a constant peripheral speed of 9000 surface feet per minute is employed to provide maximum grinding efficiency with bakelite- and rubber-bonded wheels. The machine can also be arranged to use vitrified grinding wheels. It is so designed that it can be supplied with a 7 1/2, 10, or 15 horsepower motor. Wheels of 24, 20, 18, and 16 inches in diameter can be used.

The motor is mounted at the rear and is fully protected, yet readily accessible. Maximum



Hammond Grinder for Snagging and Rough-grinding



Oliver Woodworking Planer and Jointer

power is transmitted from the motor to an intermediate drive shaft by means of the multi-vee belt. This belt can be replaced without disturbing any other member of the machine except the belt guard. Change of speeds is obtained by quick-change pulleys on the motor, which are provided with protective features that prevent the faster spindle speeds from being used with the larger wheels.

Power is transmitted from the intermediate spindle to the main spindle by means of herringbone gears which operate in a bath of oil. The wheel guards are built in accordance with the American Standards Association recommendations. These guards are adjustable to compensate for wheel wear and are fitted with shatterless glass eye shields. A Cutler-Hammer automatic motor starter protects the motor from overloads. The machine is provided with oilers having oil-level gages and flushing plugs.

OLIVER HAND PLANERS AND JOINTERS

A line of ball-bearing hand planers and jointers recently brought out by the Oliver Machinery Co., Grand Rapids, Mich., is designed to perform a wide range of woodworking operations, including squaring, smoothing, beveling, chamfering, rabbetting, grooving, tonguing, beading, cornering, and tenoning. The machines are made in two sizes, handling work up to 8 and 12 inches wide, respectively, either with the fence square or tilted to 45 degrees. The cylinder cutter-head is fitted with three high-speed tungsten-chromium steel knives.

The front and rear tables are identical, and form a planing bed 60 inches long by 9 1/2 inches wide for the 8-inch size, and 72 inches long by 13 inches wide for the 12-inch size. The tables are of the inclined bed type with the vertical adjustment obtained by means of a screw. The machines are equipped with safety guards throughout, the automatic aluminum joiner guard being so mounted as to cover automatically all that portion of the knife not actually engaged in cutting.

LINK-BELT VARIABLE-SPEED TRANSMISSION

An all-metal variable-speed transmission equipped with a positive side-tooth form of driving chain has been announced by the Link-Belt Co., Philadelphia, Pa. This speed-changing unit (see Fig. 1) has two pairs of wheels of the opposed conical disk type. Radial teeth are cut in the conical faces of these disks (see Fig. 2), and the driving chain has self-adjustable teeth which project beyond its sides and positively engage the radial teeth of the disks. By varying the distance between each pair of wheels, their effective diameters and the speed ratio are changed. These changes can be made while the transmission is under load, and it is possible to obtain a gradual variation of speeds from minimum to maximum. As these changes are made, the "self-pitching" chain rises between one set of wheels and descends between the other.

The chain is made up of a series of steel leaves or links with joints consisting of hardened steel pins turning in segmental bushings. There are no teeth on the inner surface of this chain. Instead, what may be called teeth are made up of packs of hardened steel laminations which extend through slots in the links at right angles to them, and project about 1/8 inch at each side of the chain. The individual containers which hold the packs of laminations are secured in the openings of the links, but within each container the laminations are free to slide from side to side and adjust themselves into engagement with the radial teeth of the disks over substantially the full range of diameters. The angle of the lamination ends, 30 degrees, is the same as that of the conical faces of the wheels. The teeth of the conical disks widen from the center outward, but are of uniform depth. They are so staggered, relatively on each pair of wheels, that the laminations adjust themselves to mesh correctly as the chain moves to a larger or smaller radius.

All elements of the transmission are built into and protected by a compact oil-tight housing, and are automatically splash-lubricated. The hardened steel

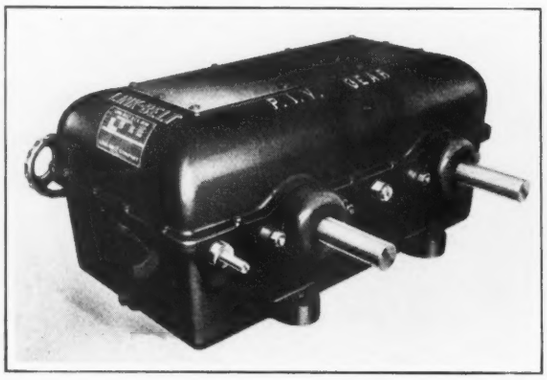


Fig. 1. Link-Belt Variable-speed Transmission with Oil-tight Housing and Splash Lubrication

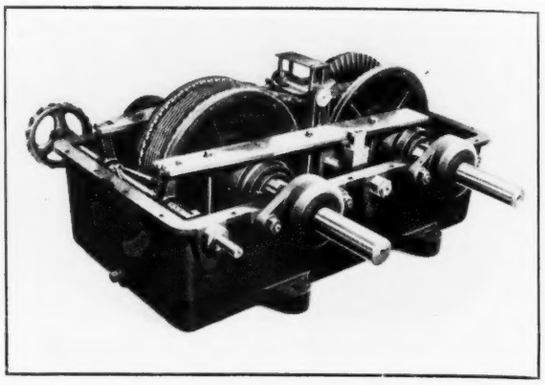


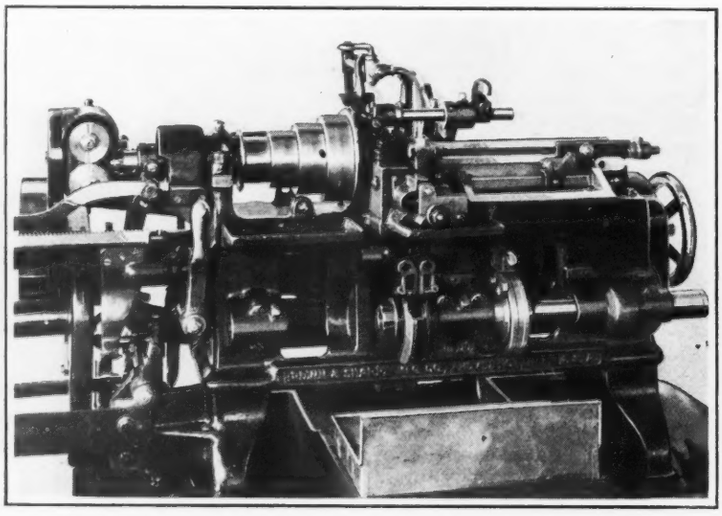
Fig. 2. Cover Removed from Transmission to Show Speed-changing Disks and Positive Chain Drive

wheel faces are mounted on cast-iron hubs backed by ball thrust bearings, and move axially on the shafts, which, in turn, are mounted in radial ball bearings. The movement of the pairs of wheels toward or away from each other, in order to increase or decrease their effective pitch diameters, is controlled by a pair of pivoted levers operated through a hand control shaft with right- and left-hand screw motion. Initial chain tension is provided for by an external adjustment screw, and correct operating tension is maintained at all ratio settings by two hardened shoes which ride lightly on both upper and lower strands of the chain under constant spring pressure (see Fig. 2). A speed indicator permits ready check-up on operating speed settings.

The transmission is made at present in five sizes, from 1 to 10 horsepower capacity, providing speed change ratios up to a maximum of six to one. It has been thoroughly tested throughout the past year by continuous operation in driving machine tools, textile equipment, baking, glass and paper-making machinery.

BROWN & SHARPE ROLLER FEED AND TIMING MECHANISM

The Brown & Sharpe Mfg. Co., Providence, R. I., has brought out a new attachment known as a "roller feed and timing mechanism" to be used with Brown & Sharpe automatic screw machines and automatic cutting-off machines. The illustration shows this mechanism applied to a cutting-off machine. On jobs requiring pieces of considerable length, this equipment saves much time, as one operation of the roller feed is sufficient to feed the piece the required distance, eliminating the multiple feedings with feeding fingers otherwise necessary. The end of each new bar is positioned at a point that permits trimming to remove the waste, leaving only a suitable amount for chucking at the last end.



Brown & Sharpe Automatic Cutting-off Machine Equipped with Roller Feed and Timing Mechanism

To determine the position for trimming, a swing stop with control mechanism is used. This stop functions only once for each new bar. The operation of the swing stop is controlled by a ratchet wheel operated by a pawl which is moved by the rear cross-slide each time a piece of work is cut off. The number of teeth in the ratchet wheel is a multiple of the number of pieces available in each 10-foot bar. As an example, the ratchet has 44 teeth, and as 11 pieces are contained in each bar, four operating dogs are necessary. These dogs are mounted on the side of the ratchet wheel and when the trimming position is reached, allow the swing stop mechanism to function. When the trimming operation is completed, the bar is again fed to the stock stop which determines the correct length of each piece available in the bar.

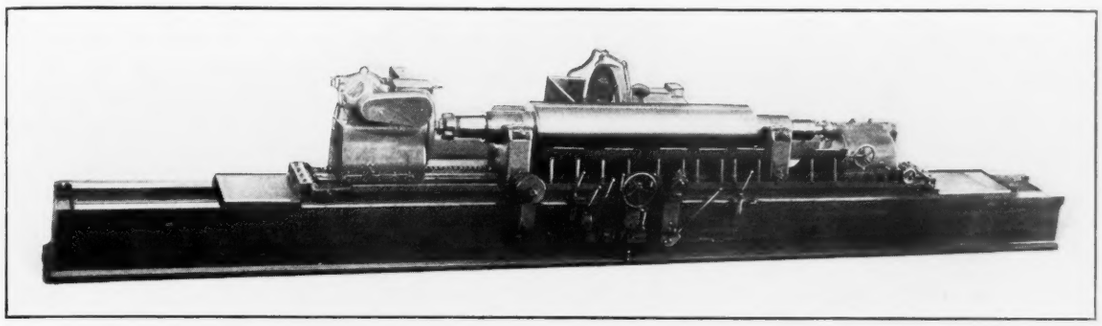


Fig. 1. Cincinnati Grinding Machine for Finishing the Barrels and Journals of Both Parallel and Cambered Rolls

CINCINNATI ROLL GRINDERS

Barrels and journals of both parallel and cambered rolls may be ground in a new line of roll grinders being introduced to the trade by Cincinnati Grinders, Inc., Cincinnati, Ohio. The particular machine illustrated is a 34- by 192-inch grinder built for handling rolls having journals arranged for both plain and anti-friction bearings. It will be seen that the machine is of the traversing table type. Five motors are employed, there being a 10-horsepower variable-speed motor for rotating the work; a 30-horsepower constant-speed motor for driving the grinding-wheel spindle; a 5-horsepower constant-speed motor for driving the feed-box that operates the table-traversing mechanism; a 1-horsepower constant-speed motor for operating the rapid traverse mechanism for the grinding-wheel head; and a 1/2-horsepower vertically mounted constant-speed motor for driving the coolant circulating pump.

The operator has complete control of the machine from a small platform. All the usual conveniences of operation are provided, including a hand-operated rheostat control of the work rotation speed; push-button start and stop switches for all motors; a selective one-lever speed change for the table traverse speeds; and a micrometer in-feed control of the grinding wheel, with an auxiliary rapid traverse mechanism for positioning the grinding wheel quickly when changing from one major diameter to another.

In view of the fact that rolls mounted on anti-friction bearings have tapered necks, it was necessary to equip the machine with a swiveling top table. Special mounting blocks fitted to the table are employed to enable rolls once fitted with anti-friction bearings to be ground on the barrel without removing the bearings. The footstock carries a radius-truing device for rounding the corners of the grinding wheel when grinding fillets in the roll ends. The footstock also carries the wheel-face crowning equipment used in grinding concave rolls.

The table traversing mechanism is of the regular Cincinnati design. The motor that drives the table also supplies power to a small pump which circulates oil under pressure to the table ways. Fig. 2 shows the general arrangement of the main drive for the grinding wheel head. The spindle of this head is mounted on preloaded S K F bearings. The drive from the jack-shaft to the grinding wheel spindle is through a Morse silent chain.

Fig. 2 also shows the general arrangement of the flexible cambering mechanism. This mechanism has been designed with a view to compensating, in grinding the roll contours, for such variables as changes in the temperature of the material being rolled, viscosity of the oil used to lubricate the rolling mill, spring of the mill under varying loads, and reduction in size of the material passed through the rolls.

Cambering of the roll surface is obtained by tilting the grind-

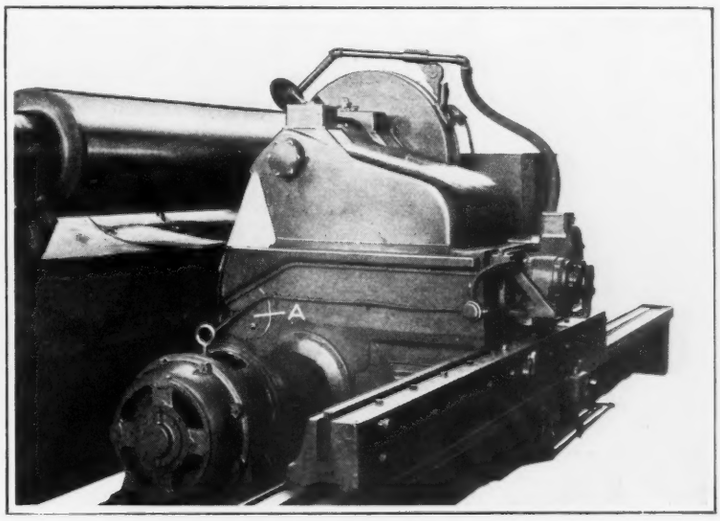


Fig. 2. Arrangement of the Cambering Mechanism

ing wheel head at the pivotal point *A*, Fig. 2. The swing of the wheel-head and its supporting base is controlled accurately by the camber bar carried in the sliding carriage seen in this illustration. The camber bar can be either of a permanent form or made from a parallel deep-section bar which may be sprung and clamped in the sprung position to meet the requirements of the particular roll being ground. An accurate indicator is provided which enables the operator to check the amount of curvature in the camber bar after it has been clamped in place.

UNIVERSAL TWO-COORDINATE MEASURING MACHINE

A measuring machine intended for general inspection has recently been developed by the Societe Genevoise d'Instruments de Physique, Geneva, Switzerland, and is being placed on the American market by the R. Y. Ferner Co., Investment Bldg., Washington, D. C. This machine is arranged for carrying out measurements in two coordinates, and it can be used for measuring forming tools, profile gages, templets, cams, small jigs, thread cutters, dies, etc. Provision is also made for testing the pitch, angle of profile, and diameters of thread gages, micrometer screws, worms, and taps by an optical method. Measurements can also be made of photographic negatives or prints.

The precision of this apparatus is embodied in two accurately graduated scales of a nickel-steel alloy having the same coefficient of expansion as the steel parts generally measured in the machine. A cast-iron bed supports two slides that move at right angles to each other on vee and flat ways. The longitudinal slide is positioned rapidly through a rack and pinion by turning a large handwheel at the front of the machine, while fine settings are made through worm-gearing. The slide carries a 16-inch precision scale in a shielded casing at the rear. Readings are taken on this scale through a micrometer microscope that reads to 0.00005 inch per division. There is also a coarse scale with an index for approximate settings.

The longitudinal slide has an opening measuring 16 3/4 by 4 3/8 inches to permit illumination from below. Parts to be measured are clamped to one of three interchangeable fixtures which are mounted on the slide. One of these fixtures is a T-slotted table that is intended for the general measuring of work or for the attachment of special work-holding devices.

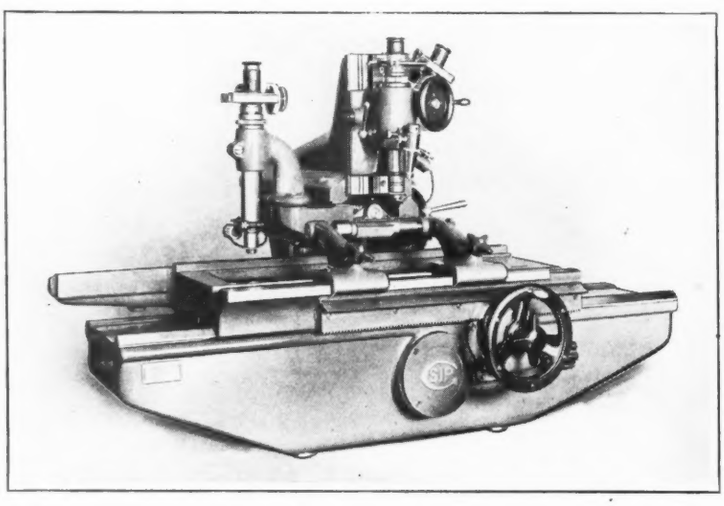
The second fixture is also a table that can be bolted to the slide, this table having a strong glass plate to permit the measurement of objects illuminated from below, such as profile gages, templets, and photographic plates. The third fixture comprises a pair of center supports which are shown in place in the illustration. These supports are used for examining pieces held between centers, such as micrometer screws, worms, and thread gages.

A transverse carriage has mounted on it the sighting microscopes for measurements in the other coordinate. This carriage is provided with a precision scale like the one on the longitudinal slide, readings being made by means of a second micrometer microscope to the same degree of accuracy.

The front part of the transverse carriage is equipped with a vertical slide on which a holder can be adjusted up and down. This holder is provided with a hardened and lapped sleeve to insure correct fitting of a locating or sighting microscope, a goniometric microscope, a punching tool, and a centering dial indicator. The latter can be used for aligning work or for measuring distances between holes.

A six-inch circular table which can be read to one inch of arc can be furnished for working in polar coordinates. A camera lucida of the Abbe-Apathy type can also be supplied for drawing objects seen in the microscope or for checking their form against a chart or drawing.

In addition to the applications mentioned at the beginning of the article, this machine may be used for checking flat gage-blocks, rules, scales on vernier calipers, and similar parts.



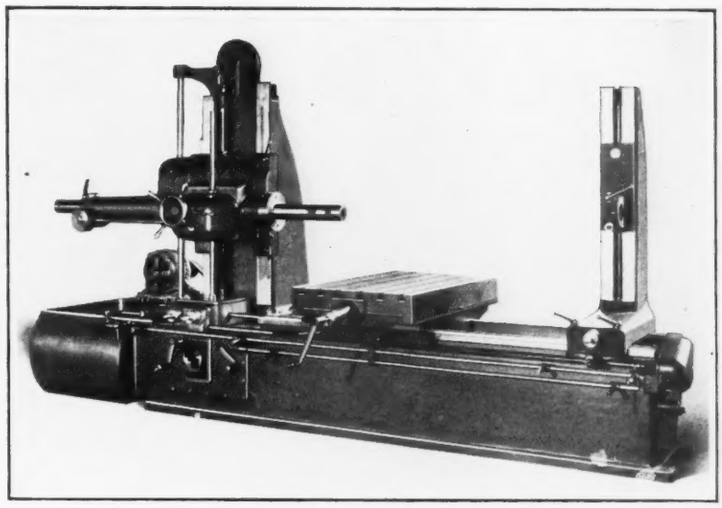
Two-coordinate Measuring Machine Made by the Societe Genevoise d'Instruments de Physique

LAMBERT HORIZONTAL BORING MILL

The design of horizontal boring mill now manufactured by the Lambert Machine & Engineering Co., of Bucyrus, Ohio, is shown in the accompanying illustration. This machine has a 4-inch bar with a travel of 30 inches. The maximum distance from the faceplate to the outer support bearing is 84 inches.

The head has a vertical power feeding movement of 30 inches, and the cross and longitudinal power feeding movements of the table are 40 inches and 60 inches, respectively. A range of twenty-four feeds is available varying from 0.004 to 0.250 inch per revolution of the boring-bar. This machine is also adapted for cutting right- or left-hand threads in various pitches beginning with four threads per inch.

The machine may be arranged either for a motor or belt drive without any alteration, and the bar may be rotated at speeds varying from 7 to 216 revolutions per minute in either direction. A multiple-disk clutch running in oil is placed between the motor and the transmission. Remote control is provided, so that the operator can start, stop, or reverse either the boring-bar or any of the feeding movements from every part of the machine. The milled lead-screws are provided with large dials graduated to read in thousandths of an inch, and verniers are also furnished for setting the head and the outer support bearing. Any feeding movement selected will remain constant independent of the speed of the bar. A 7 1/2-horsepower motor is required, and the approximate weight of the machine is 16,000 pounds.



Lambert Horizontal Boring Mill

MONITOR OIL-IMMERSED MOTOR STARTER

An oil-immersed starter consisting of an oil-tight box enclosing a magnetic contactor mounted on a panel with a thermal relay has recently been placed on the market by the Monitor Controller Co., Gay, Lombard and Frederick Sts., Baltimore, Md. The contactor and the contacts of the relay are completely immersed, while the thermal contacts are above the oil level.

This equipment known as the "Oil-Immersed Thermaload Starter," is built to give positive protection to polyphase and single-phase motors both while starting and while running. It permits full-voltage, full-current, and full-torque starting, and yet protects the motor from harmful overloads. It will also disconnect the motor if the voltage fails or drops excessively, and will prevent damage to polyphase motors in case one of the phases goes dead and overloads the other.

MILWAUKEE SIMPLEX MILLING MACHINE

Spindle speeds up to 1000 revolutions per minute are obtainable on a production type milling machine now being introduced on the market by the Kearney & Trecker Corporation, Milwaukee, Wis. This machine has been designed to permit suitable application of cemented tungsten-carbide cutters. Three standard speed ranges, with twelve speed changes each, are available. The ranges are from 15 to 150, 30 to 300, and 100 to 1000 revolutions per minute.

The machine is constructed of five major units—the bed, double uprights, spindle block, saddle, and table. The bed contains all the operating units, including a motor, main driving clutch and brake, speed and feed gear units, coolant and lubricant pumps, and reservoirs.

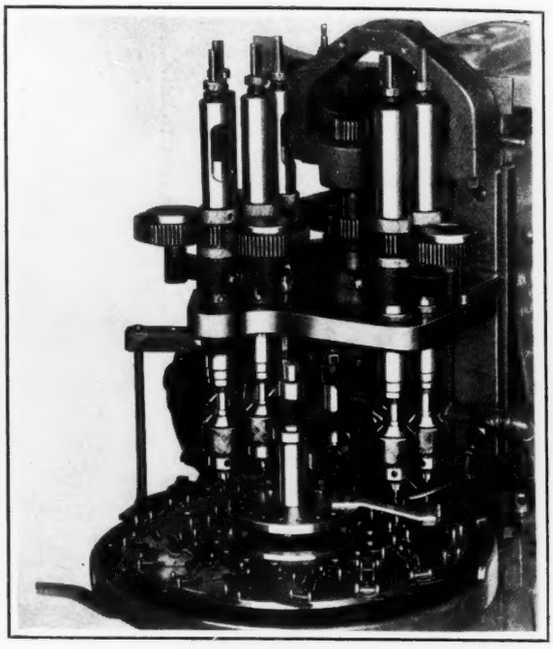
An important feature of the construction is a heavy brace that ties the spindle quill to the double over-arms and thus provides a stiffening support throughout the entire cross-adjustment. When the spindle quill is moved outward, this brace goes with it. The quill is locked in the spindle block by two clamps located at the right-hand side of the spindle block uprights. Cross-adjustments are obtained through a hand-crank attached to the squared end of a shaft provided with a dial graduated to thousandths of an inch.

Herringbone gears are employed for the spindle drive. The gear is mounted solidly on the spindle and the driving pinion is splined. This construction insures a positive drive to the spindle throughout the entire cross-adjustment of the quill. The spindle is mounted in three roller bearings, two of which are of the tapered type, while the third is of straight design.

With a view to providing extra strength for the higher cutting speeds, the spindle block is mounted between heavy double uprights. The block has bearing surfaces extending its full length, is guided and aligned by a deep-tongued slide, and is held in adjusted positions by a full length gib. When the spindle block is clamped in place, the entire head becomes practically a solid unit. Vertical adjustment of the spindle block is accomplished through a hand-crank located on the right-hand side of the bed.

A coordinated adjustment for the arbor and over-arm braces is another feature of the con-

Milwaukee Production Type Milling Machine



Anderson Tapping Machine with Dial Feed

struction. When the cutters are being adjusted in or out, the entire unit moves with the hand-crank. Eighteen feeds are available in two ranges of from 1/2 to 20 inches or from 1 to 40 inches per minute. Feed changes are made by means of pick-off gears which are accessible through a hinged door. The power rapid traverse is at the rate of 240 inches per minute. Table dogs that control the feed and rapid traverse movements are located in a built-in compartment at the front of the table and are fully protected by a cover plate from all dirt and chips.

With the exception of the outer bearings of the table screw, the entire machine is lubricated automatically by a gear pump, which is driven from the main drive shaft, so that when the motor runs the pump operates. Coolant is distributed by another gear pump operated automatically when the spindle is engaged. The machine is equipped with a multiple V-belt drive consisting of four belts. The motor is mounted on a pivoted bracket for convenient adjustment of the belt tension. Either 5- or 7 1/2-horsepower motors can be used.

This Milwaukee Simplex machine is offered in two series designated as the 1200 and 1800, the first two numerals of each series designating the table width. The weight of the machine is about 8000 pounds.

ANDERSON DIAL-FEED TAPPING MACHINE

A dial tapping machine of multi-spindle construction, so designed that the spindles can be interchanged in master plates to suit the work to be handled, has recently been brought out by the Anderson Die Machine Co., Bridgeport, Conn. The spindle bores in the master plates are located to correspond with the holes in the parts to be tapped, the master plate being secured to a machined portion of the tapping slide. The spindle bores are also located with respect to the number of teeth in the dial index ratchet and the position of the part to be tapped on the dial.

One advantage of this method is that any spindle can be transferred from one master plate to another, thus reducing the setting-up time and yet insuring correct alignment of the spindles with the holes to be tapped. The illustration shows a set-up for tapping four holes. It will be noted, however, that six spindles are used; the last two serve as finishers for the two most important holes in the part. These master plates may be adapted to a great many forms of work, and with their corresponding dials, are easily stored when not in use.

The master plates for this machine, which is known as the No. 40, may be purchased either with or without spindles. It is, however, advisable to have the dial and plate made at the same time, so that the plate can be accurately bored to suit. These plates may also be procured to suit any dial on hand.

TOLEDO PRESS OF HUGE DIMENSIONS

A toggle press of such gigantic size that it was necessary to build it in a pit has recently been constructed by the Toledo Machine & Tool Co., Toledo, Ohio. This press is of the double-action type, and is used for drawing and deep stamping work. The toggle mechanism, which operates and controls the tool of the blank-holder slide, is located in the crown to permit the use

of twin gearing and also to give a compact arrangement as well as great strength.

An idea of the capacity of the press may be obtained from the following figures: Stroke of plunger slide, 45 inches, with an adjustment of 10 inches by means of a power elevator provided with a 10-horsepower reversible motor running at 1200 revolutions per minute; distance between uprights, 69 inches; size of plunger, 50 inches front to back by 42 inches right to left; dimensions of blank-holder, 68 inches front to back by 57 inches right to left; size of top of the bed, 68 by 68 inches; die space with plunger at bottom of stroke, 80 inches, including adjustment; thickness of bolster plate, 8 inches.

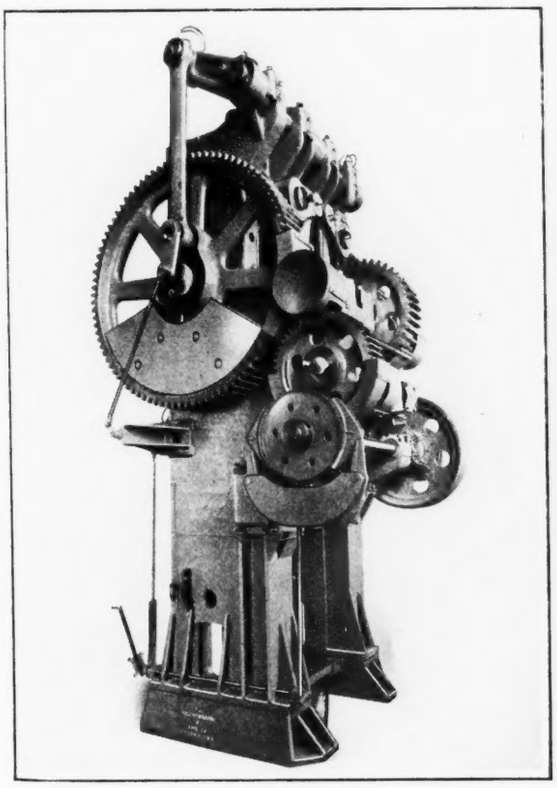
The flywheel is 72 inches in diameter, weighs 11,000 pounds, and has a 24-inch face. The twin gears on the main shaft are 125 inches in diameter with 16-inch faces. The press is triple geared, with a ratio of 80 to 1, and makes 3 7/8 strokes per minute. The crankshaft has ample capacity for drawing 1/8-inch thick stainless steel shells 24 inches in diameter by 24 inches deep.

The press weighs 450,000 pounds, has a total over-all height of 422 inches, and requires a driving motor of 200 horsepower. All of the toggle operating parts are steel castings, bronze-bushed. Equipped with the Toledo patented disk friction clutch with independent brake, absolute control of the press is maintained at all times. The clutch mechanism is so arranged that the press may be operated continuously or stopped at any part of the stroke; or by changing the position of a small stud, the press may be started as usual, and will stop automatically at the top center.

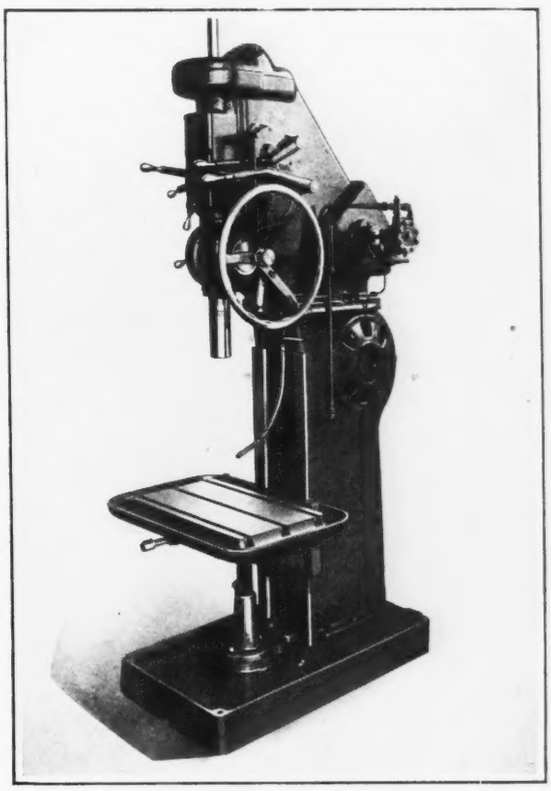
BARNES DRILL CO.'S DRILLING AND TAPPING MACHINE

A general-purpose drilling and tapping machine, of 20-inch swing, has recently been added to the line of the Barnes Drill Co., 814 Chestnut St., Rockford, Ill. This machine is designed for continuous production, and has a capacity for driving high-speed twist drills up to 1 1/4 inches in diameter in steel of S. A. E. specification 1035. There are six quick-change speeds—three without back-gears. Six quick changes of feed are obtainable through spur gears, which eliminate the usual worm and worm-gear. Power feeds may be engaged or disengaged while the spindle is running idle. All operating levers extend to the front of the machine to permit ease of control, and an automatic stop is provided for controlling the drilling depth. To prevent overloading and to minimize breakage of twist drills, a special safety device is incorporated in the feeding arrangement.

This machine (the No. 201 1/4) is similar in style to the Nos.



Toledo Press with Capacity for Drawing 1/8-inch Stainless Steel Shells 24 by 24 Inches



General-purpose Drilling and Tapping Machine Made by the Barnes Drill Co.

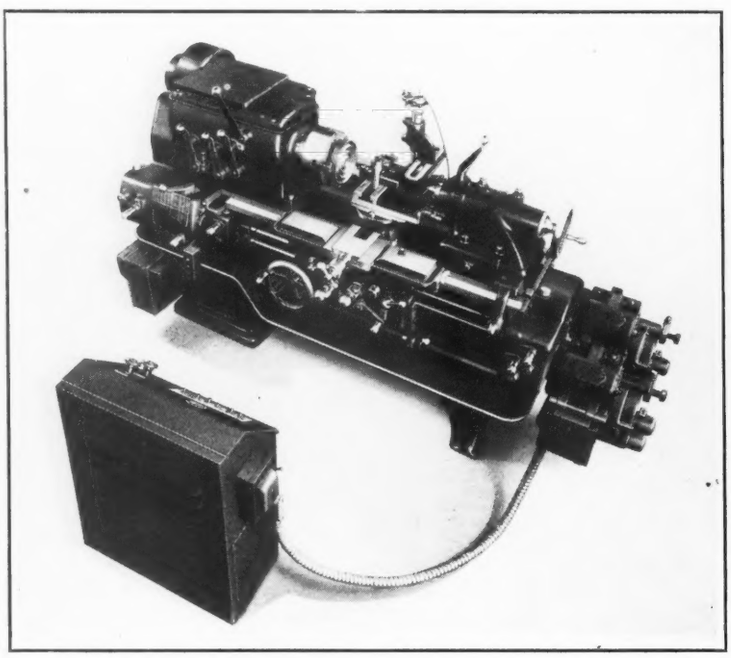
221 1/2 and 242 sizes used for heavier work. The head is a unit in itself, and contains all the working parts, including the pump for the self-oiling system as well as the coolant pump. These heads are also designed in gang style for from two to six spindles. For tapping, a reversible multiple-disk clutch and spiral gears are employed, the clutch being controlled by a lever provided with a depth stop for reversing the tap automatically at any predetermined depth.

When specified, sectional posts for varying the height of the table by increments of three inches will be furnished in place of the regular raising screw. These posts practically eliminate deflection of the table. Compound tables having a cross-travel of 20 inches and an in-and-out travel of 8 inches may also be had on these machines. The graduations on the operating screws may be in either millimeters or inches. Vernier scales for cross, longitudinal, and vertical travel may also be obtained at extra cost. The machine can be driven either by a silent chain or a V-belt from a 3-horsepower motor rotating at 1200 revolutions per minute. On the driving shaft is assembled a self-oiling multiple-disk clutch gear with a band brake which automatically stops the rotation of the spindle as soon as the clutch has been released.

MONARCH-KELLER AUTOMATIC FORM-TURNING LATHES

A large variety of form-turning operations may now be controlled automatically by means of the Monarch-Keller form-turning lathes. These machines, made by the Monarch Machine Tool Co., Sidney, Ohio, are applied to such work as turning die-casting dies, molding and forming dies of all kinds, spinning chucks, formed cutters, and metal-bending rolls, and turning or facing any special shapes that can be reproduced in the form of a thin master templet.

The illustration shows a lathe set-up for turning a corrugated die 8 inches in diameter. The master templet is mounted on a bracket at the back of the lathe in a position corresponding to that of the surface to be turned.



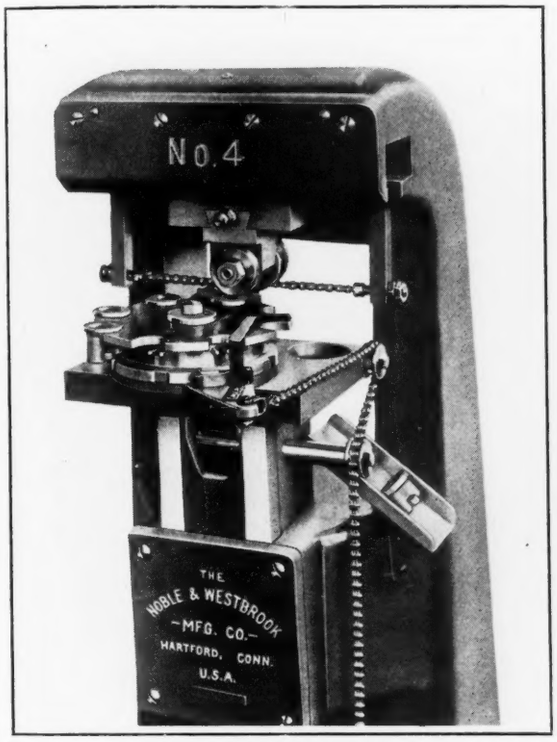
Monarch-Keller Form-turning Lathe which Automatically Reproduces the Shape of a Thin Master Templet

Above this templet, and on an extension at the rear of the cross-slide, may be seen the tracer unit. After a directional switch button is pressed, the tracer point or finger automatically maintains a light mechanical contact with the templet. The contour of the templet, along which the tracer moves, is reproduced by the movement of the cutting tool as the result of electrical contacts, relays, and magnetic clutches, which control the tool-slide movements.

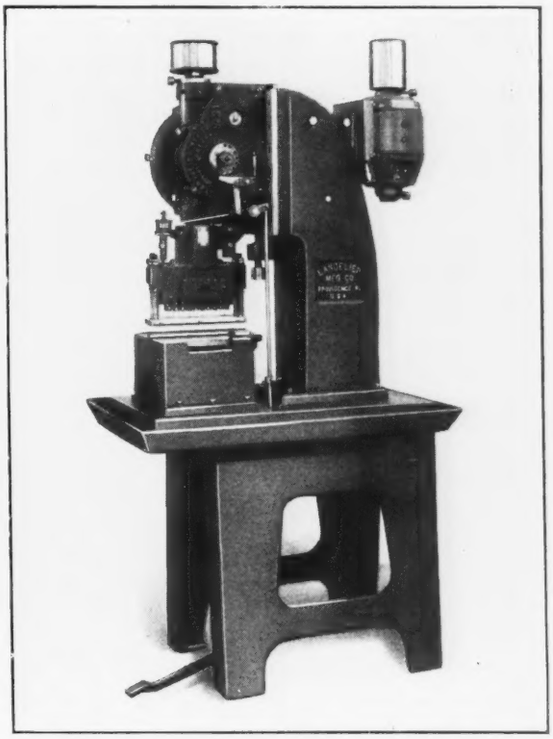
The electrical control units are supplied by the Keller Mechanical Engineering Corporation and are the same as those used on Keller electrically controlled machines. The Keller control cabinet seen in front of the machine in the illustration is conveniently located for the operator so that the directional controls are within easy reach. Two control knobs on this unit provide ninety-six changes of feed for both lengthwise and cross feeds.

The thin master templet can be made of sheet steel, zinc, brass, or other metal, and its form is reproduced within limits as close as 0.001 inch. Whenever required, heavy cuts can be taken in form-turning, the same as when using a standard lathe not equipped with the Keller controls. All functions are controlled by push-button switches clearly marked and located in the control cabinet.

This automatic control for form-turning can be applied to all types of Monarch lathes and all sizes from 14 to 36 inches swing. However, it is a built-in feature and not intended for lathes now in use. Direct current not exceeding 5 amperes is required for operating the Keller control unit. The automatic form-turning lathe may also be used as a standard engine lathe. The quick change gear box of the lathe, as well as the end gearing, does not operate when the automatic form-turning equipment is in use. By changing the position of three levers, the quick change gear box is engaged and the Keller unit disconnected, so that the lathe can be used for ordinary work. The change back for automatic form-turning is made just as readily.



Machine for Embossing Names and Trademarks on Locks



Langelier Drilling Machine with Twenty-spindle Head

NOBLE & WESTBROOK EMBOSSING MACHINE

Locks of some leading makes have the name and trademark embossed in raised letters or designs on the escutcheon over the keyhole. To enable this embossing to be handled on a production basis, the Noble & Westbrook Mfg. Co., 20 Westbrook St., East Hartford, Conn., has built the machine here illustrated. The embossing is done by a cylindrical die mounted on a reciprocating slide which is driven by a rack and pinion from a motor in the machine base. A chain keeps the embossing die registered with the work as it rolls across the surface to be embossed. This feature permits the die to be passed over the work a number of times and also allows it to be started from any position.

The work is placed on an indexing table at the front of the machine which has eight work-holding stations and automatically carries the pieces into the marking position. Pressure for the embossing operation is applied by the foot of the operator. On releasing the pressure, the table is automatically indexed to the next station and the finished piece ejected through a chute into a work-box.

LANGELIER TWENTY-SPINDLE DRILL

Twenty spindles, spaced 7/8 inch apart in two rows, are contained in the head of the machine here illustrated, which was built recently by the Langelier Mfg. Co., Providence, R. I. While this machine was designed primarily for drilling holes in the backs of books to facilitate sewing, the machine is also adapted for drilling metal. It is equipped with the No. 31 automatic drilling unit made by this concern.

The drilling head is clamped to the feed sleeve of this unit, and the spindles are driven by inter-connected spur gears. Each of the two parallel rows of spindles is provided with a spring steadyrest which slides on guide rods in the head and acts as a stripper. The spindles run at a speed of 5000 revolutions per minute. They are fitted with split collet chucks for holding 1/16-inch drills. The drilling head is surrounded by a cast water jacket designed to keep this unit cool.

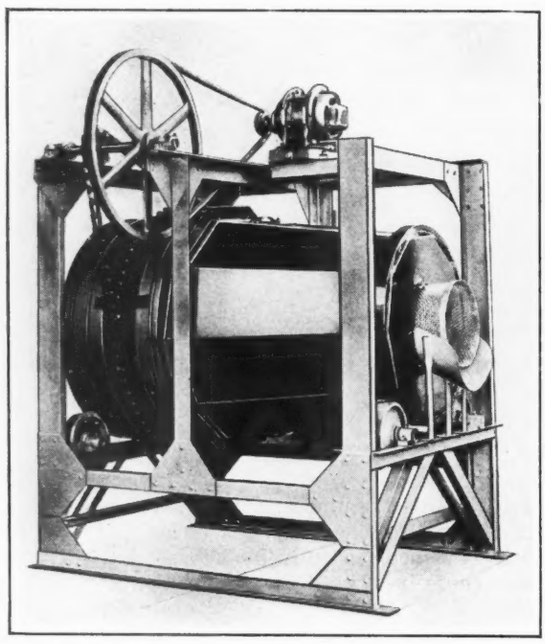
The feed for the automatic drilling unit is obtained from a cam, which gives a quick approach, a feed, a dwell, and a rapid return. The cam is timed to make one revolution in three seconds and allow a 1 1/2-second pause for the operator to replace the work. The cam can be run continuously or tripped at each cycle by means of a foot-pedal. This machine, which is motor-driven, occupies a floor space of 28 by 44 inches, is 80 inches high, and weighs approximately 1000 pounds.

BALL BURNISHING BARREL

Rehandling of burnishing balls is entirely eliminated in the "Ideal" burnishing barrel recently introduced by N. Ransohoff,

Inc., Cincinnati, Ohio. The work is charged into the barrel, and the barrel is then rotated in one direction to give the work the required burnish as it circulates among the balls. After the parts have been sufficiently burnished, the operator reverses the rotation of the barrel. This causes the work and the balls to be discharged into a cylindrical screen passing through the center of a metal cone within the barrel.

Here the work and the balls are automatically separated, the work passing out of the barrel at one end, while the balls pass through the screen and into the metal cone. By reversing the rotation of the barrel again, the balls are automatically returned to the burnishing chamber ready for the next batch of work.

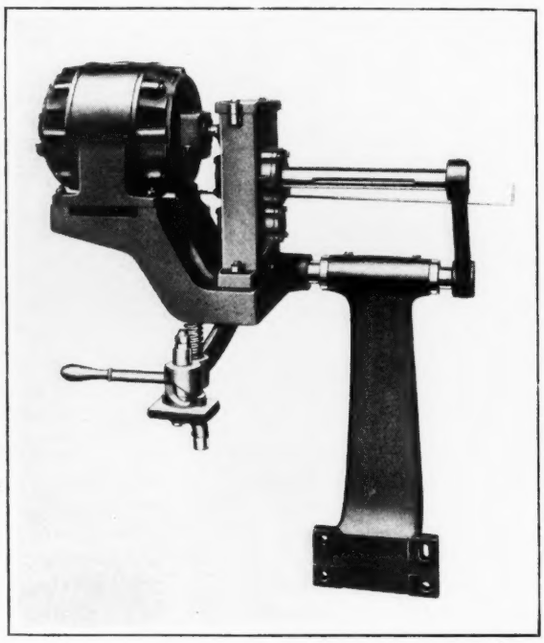


Burnishing Barrel which Automatically Separates the Burnishing Balls from the Work

CULLMAN LATHE DRIVE ATTACHMENT

An individual motor unit which can be quickly and easily attached to cone pulley lathes of from 14 to 36 inches swing, has recently been placed on the market by the Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill. This drive unit is supported by means of a bracket mounted at the rear of the headstock and secured to the lathe bed by four clamping bolts. At the upper end of this bracket is mounted a shaft on which the driving mechanism bracket pivots. On the latter bracket is assembled a motor and a Cullman speed reducer having a shaft extension for the driving cone pulley.

The motor is provided with a reversible drum switch, which has an extension located conveniently for the operator. An adjustment for obtaining the proper belt tension and facilitating the shifting of the belt is obtained by means of a short lever which serves to move the entire unit up or down. The driving cone pulley is the one used originally on the old countershaft.



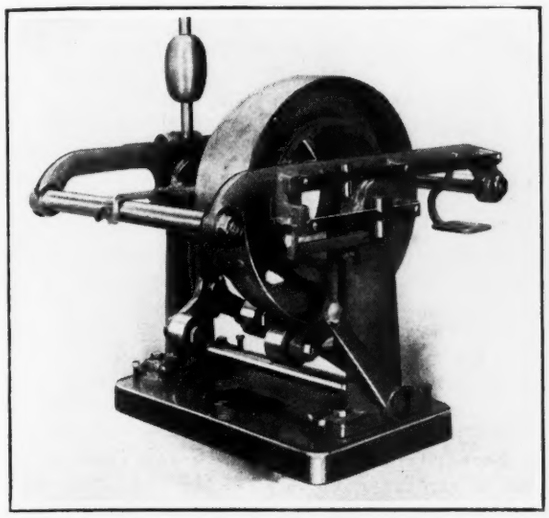
Cullman Lathe Drive which Includes a Motor and Speed Reducer

"ZENCROMATIC" STATIC BALANCING MACHINE

The amount of unbalance in flywheels, ring gears, clutches, automobile tires, etc., can be determined and the exact position of the unbalanced area located in the static balancing machine here illustrated, which has been developed by the "Zencromatic" Co., Sheboygan Falls, Wis. The standard machine is made for balancing parts 20 inches in diameter and from 7 to 31 inches in width. When required for high-production work on flywheels or clutches, the machine is made with a drill press attachment for removing metal to bring the work into balance. With this equipment, 350 wheels can be balanced per day.

The balancing is done by locating a knife-edge at the center of the part to be balanced, so that the part simply tips over on a hardened and sensitive knife-edge. The work is then turned in the direction in which it tips until a point is reached where the scale beam indicates a condition of balance with no tipping of the work. When this is accomplished, the heavy side will be exactly under the point of contact of the knife-edge. With this method, no central work arbor is used, as the turned or finished outer surface rests on two or four rolls which are adjustable to bring the work in line with the knife-edges.

After the heavy point on the work has been located, the part is turned by hand through an



"Zencromatic" Balancing Machine

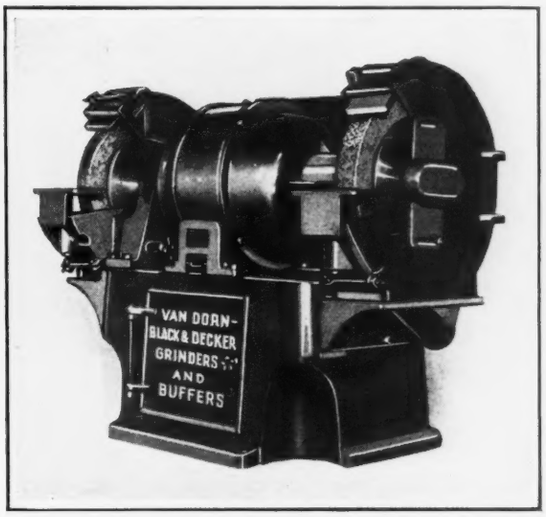


Fig. 1. Grinder with Automatic Speed Control

angle of about 90 degrees. Sliding weights are then adjusted on the scale beam until the work is in balance. The scales show how much material must be removed from the work. If the balancing weights are made to correspond with the amount of metal removed by a certain size drill, the position and depth of the hole or holes required to balance the work can be readily determined. In the case of parts that must be balanced by adding weights, the balancing is accomplished by placing the weights directly on a pan which can be slid along a bar. The pan can then be adjusted to the radius at which the weights are to be fastened.

BLACK & DECKER GRINDERS

In Fig. 1 is shown a 24-inch stand grinder with an automatic speed control for maintaining cutting speeds of 6000 or 9000 surface feet per minute, which is being placed on the market by the Black & Decker Mfg. Co., Towson, Md. The constant speed feature has been developed to prolong the life of the grinding wheel and to permit metal to be removed quicker and with less effort on the part of the operator. The speed is controlled by means of a rheostat link connected to the wheel guard. The speed of the motor is thus advanced automatically as the guard is adjusted or moved forward when the wheel becomes smaller through wear. The tool-rest is mounted on the guard, so that it is necessary for the operator to adjust the tool-rest and guard as the wheel wears down. In making this adjustment, the spindle speed is automatically increased, so that the surface or cutting speed is kept practically constant. The grinder is equipped with an extra heavy duty motor built for continuous operation.

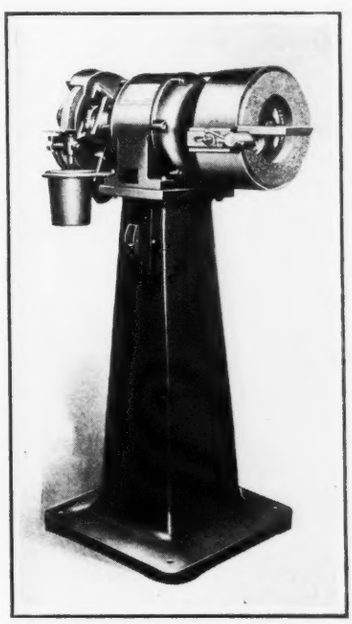
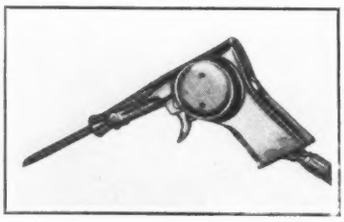


Fig. 2. Black & Decker Grinder for Resharpening Tools Tipped with Tungsten Carbide

Another addition to the line of grinders made by this company is the 10-inch precision grinder shown in Fig. 2. This machine is designed especially for grinding and resharpening tungsten-carbide tipped cutting tools. A special adjustable tool-rest with a self-contained graduated scale provides means for grinding the tools to the proper cutting angles. This grinder is made in two types, one being equipped with a 10-inch cup type wheel on the right spindle and a 10-inch straight side wheel on the left spindle. The other type is equipped with two 10-inch cup type wheels.

KIPP AIR-DRIVEN CHIPPER

The Kipp "air chipper" is a new device developed by the Madison-Kipp Corporation, 203 Waubesa St., Madison, Wis. This air-driven chipper delivers over 6000 blows per minute to the chisel. The resultant rapid pulsating effect provides an even flow of power when the chisel is pressed against the work by the operator. The intensity of the blows is regulated by the pressure the operator exerts against the chisel, and also by the position of the trigger valve; that is, lighter cuts may be taken with less pressure on the handle and



Air-driven Chipper Developed by Madison-Kipp Corporation

with less pressure on the trigger valve. The operator, therefore, has extremely close control of his work so that he may work to a line and stop at a line.

As shown in the illustration, the Kipp air chipper has a pistol grip and a body or housing of pistol shape. The chisels are inserted into the barrel and held there by means of a spring clamp. The chisel shanks are pentagon and may be inserted with any of the five sides in an upward position. The chipper itself will operate in any position. The design of the chipper eliminates vibration in the grip hand of the operator, so that fatigue and nerve strain are absent.

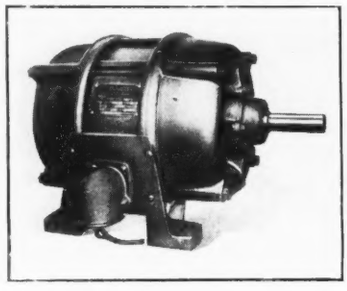
The Kipp air chipper was developed to provide a substitute for the slow and uncertain hand chipping and grooving in making Madison-Kipp die-casting dies. The work done by the air chipper complements the work of the Kipp air grinder. (See MACHINERY, February, 1930, page 473.)

The air chipper may be used effectively, not only for tool and die work, but for metal and wood pattern making, and for a great many special riveting, chipping, and grooving operations in the mechanical industry. A variety of chisels is available, shaped to meet the needs of a wide range of work. Blank chisels are provided so that shapes may be ground to suit special requirements.

The air chipper operates under air pressures of from 60 to 100 pounds. The air enters the mechanism through an air hose connected to the handle or pistol grip. The air is controlled by the trigger valve, which, when pressed, admits air to a rotary valve die cast on an air turbine. The exhaust air revolves the air turbine and the rotary valve which directs the air from one side of the hammer to the other.

The reciprocating action of the hammer imparts a pulsating energy to a floating striker shaft located on the forward end of the hammer cylinder. This striker shaft, in turn, drives the chisel when pressure is applied to the work by the operator. An air cushion absorbs vibration on the reverse stroke of the hammer.

The speed of the hammer is fixed by the speed of rotation of the turbine. Thus, when the speed of the turbine is 6000 revolutions per minute, there will be 6000 forward and reverse strokes to the hammer, which means 6000 chisel blows per minute. The weight of the Kipp air chipper is 1 1/2 pounds, and the length is 5 5/8 inches.



Unit Type Standardized Motor Made by the Ideal Electric & Mfg. Co.

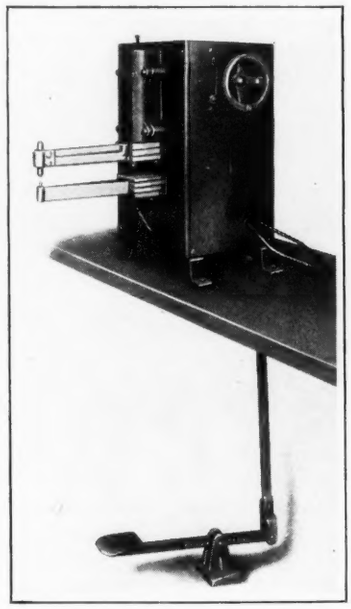
UNIT TYPE MOTORS

The Ideal Electric & Mfg. Co., of Mansfield, Ohio, has developed a series of electric motors that represent complete standardization in so far as it will benefit industry and simplify construction. These motors are built with standardized units which are interchangeable for all types. Thus standard horizontal motors, shell type motors, flange type motors, vertical motors, special applications of "built-in" motors requiring only active elements, etc., all take the same rotors and stators. Interchangeable standardized rotor and stator units, end brackets, bearings, and bases are provided not only for squirrel-cage induction motors, but also for slip-ring induction motors and direct-current motors.

All unit type motors are designed to meet the standard torques, power factors, efficiencies, heating specifications, dielectric tests, and other performance guarantees, and also the uniform mounting dimensions established by the National Electrical Manufacturers' Association. They are furnished in sizes of from 1/2 to 200 horsepower.

"AMERTRAN" SPOT-WELDING MACHINE

A spot-welding machine with a capacity for welding two sheets of 3/16-inch steel or two sheets of 1/16-inch copper or brass with a 1/4-inch spot weld has been brought out by the American Transformer Co., 178 Emmet St., Newark, N. J. This equipment is known as the "AmerTran B-5" spot-welding machine, and has a semi-automatic device which opens the primary circuit as required, permits the weld to "freeze" under pressure, and prevents arcing at the electrodes. The pressure is also adjustable for various types of work and is applied by a heavy spring rather than by the operator. Thus the machine is adapted for welding copper and brass, for resistance soldering, and for applications requiring heavy pressure.

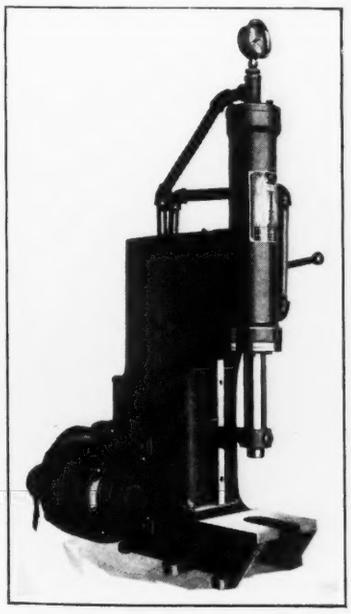


AmerTran Spot-welding Machine

The machine is a bench-type unit, as shown in the illustration, and is mounted in a sheet-steel case, 12 by 14 inches by 28 inches high. It operates from a standard 220-volt 50-60 cycle circuit, and is available in three sizes of 5, 7 1/2, and 10 kilovolt-amperes. The two electrodes protrude 15 inches from the front of the case and are available in various types. The space between the points is adjustable, and when the welder is to be used continuously, water-cooled electrodes are provided. Standard equipment includes a foot-pedal control and a six-point primary switch for adjusting the welding current to suit the job.

AMERICAN HYDRAULIC BENCH ARBOR PRESS

A hydraulic bench arbor press, designated the V-O, has recently been placed on the market by the American Broach & Machine Co., Ann Arbor, Mich. This machine is operated as a self-contained unit, and is intended for attachment to a bench or lathe bed. It is driven by a one-half horsepower motor which transmits the power through a roller chain. The pump is submerged in oil within the column, the latter serving as an oil reservoir, and having a capacity for four gallons. The machine is equipped with a direct-reading gage which indicates the amount of pressure exerted.

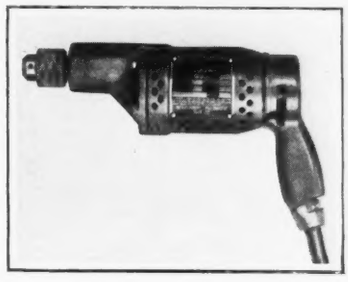


American Hydraulic Arbor Press

Some of the principal specifications are as follows: Stroke, 12 inches; speed of ram, 60 feet per minute; maximum pressure exerted, one ton; and total height, 41 inches.

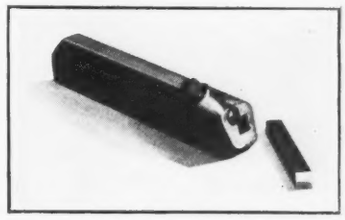
THOR HIGH-FREQUENCY ELECTRIC DRILLS

Six drills have been added to the line of Thor high-frequency electric tools manufactured by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. These tools are of the midget type, three being made in a bonnet style and three in the grip switch style shown in the illustration. The bonnet style fits the palm of the hand, and is made light in weight to facilitate handling. It is similar in appearance to the style illustrated, but does not have the projecting grip.



Thor Electric Drill with Grip Handle

These drills are especially designed for fast drilling on such work as automobile body trimmings, metal furniture, steel shelving, radios, and electric appliances. The three drills made in the bonnet style operate at speeds of 2300, 2790, and 3700 revolutions per minute, respectively. Each of these drills has a capacity of 1/4 inch, an overall length of 9 1/2 inches, and a weight of three pounds. The three drills of the grip switch style have the same specifications except that each weighs about four pounds.



Four-grip Tool Bit Holder

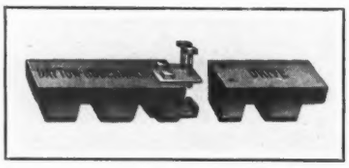
FOUR-GRIP TOOL BIT HOLDER

The Four-Grip Tool Co., 107 E. Seventeenth St., Paterson, N. J., has brought out a new tool-holder in which the tool bit is held securely along four surfaces, a V-block being interposed between the clamping screw and the bit to equalize the clamping pressure. This method of clamping is especially advantageous when the bits are of brittle composition and likely to break easily under strain. The tool bit is clamped in position by means of a "Mac-it" set-screw which transmits an even pressure along the tool bit, through the provision of the V-block, holding the bit rigidly in its seat. This tool-holder is particularly valuable when used in connection with the new tungsten-carbide cutting tools.

HOUGHTON "TENAC" GEAR LUBRICANTS

Gear lubricants known as "Tenac" are now made in a series of grades numbered 1, 2, 3, and 4 by E. F. Houghton & Co., Third, American, and Somerset Sts., Philadelphia, Pa. These lubricants are intended for use on all types of heavy, slow-moving open gears, No. 1 being the heaviest and No. 4 the lightest grade of the series.

In developing these lubricants, extensive tests were made with the view of obtaining a lubricant that would maintain an unbroken lubricating film and that would not be thrown off when the gears are in motion. One of the important features is the ability of the lubricants to provide satisfactory lubrication at low temperatures.



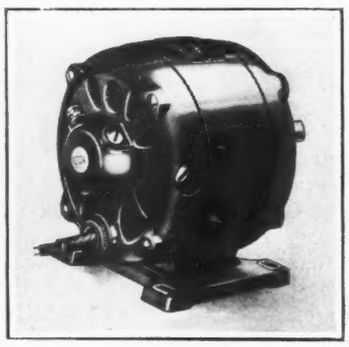
Section of Roderwald "Link-Wedge" Belt

RODERWALD "LINK-WEDGE" BELT

A vee-shaped belt known as the Roderwald "Link-Wedge" belt is being placed on the market by the Dayton Rubber Mfg. Co., Dayton, Ohio. This belt is constructed of fabric and rubber and was perfected by Herr Roderwald, president of the Roderwald Co., Berlin, Germany. The belt is constructed with internal cogs on the inside and runs on a standard vee-shaped pulley. It is flexible, and can be adjusted to any desired length, a metallic clip being used to join the ends. The belt is adapted for power drives ranging from fractional horsepower sizes up to sizes which transmit thousands of horsepower.

BODINE MOTOR WITH WOOL-PACKED BEARINGS

A Type N-5 electric motor, made in two frame sizes rated at 1/20 and 1/12 horsepower at 1125 revolutions per minute, and 1/10 and 1/8 horsepower at 1725 revolutions per minute, has been brought out by the Bodine Electric Co., 2254 W. Ohio St., Chicago, Ill., to replace the SA and SD types previously made by this company.



Bodine Electric Motor with Wool-packed Bearings

The Type N-5 frames have larger cooling fans and are equipped with wool-packed bearings. Double oil slots are provided to give adequate lubrication without flooding the bearings, which are totally enclosed by dust caps.

"MIKROTAST" PORTABLE STEEL BALL GAGE

A gage for testing steel balls, both for out-of-roundness and size, has recently been placed on the market by the Coats Machine Tool Co., Inc., 110 W. 40th St., New York City. This gage consists chiefly of a standard Krupp "Mikrotast" indicator which may have forty graduations, each of which represents 0.00005 inch, or fifty graduations each representing 0.0001 inch. The indicator is connected to an adapter which carries at its lower end a conical cup made of "Nitralloy." The top of the cone is cut away to permit the entrance of a gage contact point.

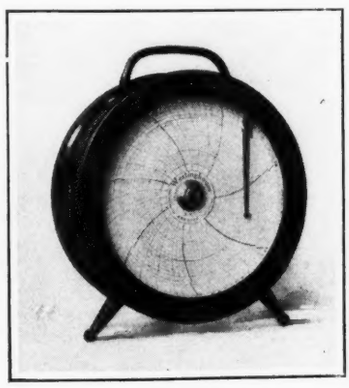
"Mikrotast" Gage for Testing Roundness and Diameter of Steel Balls

To set the gage, a master ball is used, after which duplicate steel balls may be inspected by simply resting the gage on the ball which seats itself within the cone. It is common practice to support the balls on a glass plate and roll each ball over this plate while it is in contact with the gage. In order to permit easy reading and avoid eye-strain, the dial is equipped with red tolerance markers. Four adapters are provided with each gage to cover all ball diameters between 0.400 and 1.200 inches.

WESTINGHOUSE RECORDING INSTRUMENT

A circular chart recording instrument, designated as the Type A, has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Some examples of its applications may be found in determining the most economical operation of motor-driven machinery, the loading of motors, the time of starting and stopping equipment during the day, as well as loss of time; the power required for different operations or depth of cuts may also be determined. This instrument includes an ammeter, a voltmeter, and a clock, and is made for switchboards or for portable use.

The measuring unit of this instrument consists of a small motor structure, in which a laminated armature core or rotor is mounted in the field of an electromagnet. The control force is maintained by heavy springs. The main shaft operates the pen directly, and the mechanism as a whole is damped by means of an aluminum disk arranged to swing in the air gaps of a powerful set of permanent magnets. The clock for moving the circular chart may be either a key-wound eight-day clock for one-week charts, a key-wound thirty-six-hour clock for one-day charts,



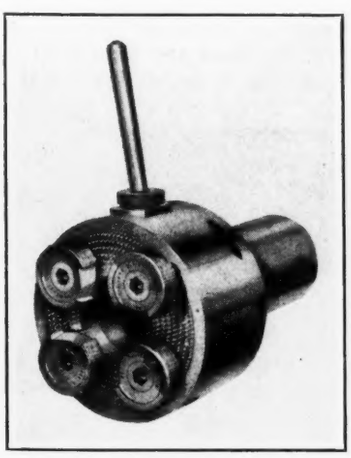
Westinghouse Recording Instrument for Various Applications

or a sub-synchronous (self-starting) motor-driven clock operated by the system frequency. Change-gears are available for changing the motor speed of the latter type of clock.

"NAMCO" STATIONARY-TYPE OPENING DIE-HEADS

Self-opening die-heads equipped with circular chasers and designed for use on screw machines, turret lathes, and other machines having non-rotating die-holders have been brought out by the National Acme Co., Cleveland, Ohio. These dies, which have been designated the "Namco DS," embody all the features of the DR type intended for use on machines having revolving spindles, which were described in the June, 1930, number of MACHINERY, page 831. Chaser blocks and chasers of the DS and DR types are interchangeable in the corresponding die sizes.

The DS die-heads are made in seven sizes ranging from 3/8 to 3 3/4 inches. The chasers are located by serrated steel buttons, and each chaser is held in place by means of a hollow-head screw. Any chaser can be replaced without changing the entire set. There are only four major parts to the die-heads—the cup, body, adjusting plate, and shank. The die-head construction facilitates close-to-shoulder threading.



"Namco" Die-head Designed for Use where the Work Revolves and the Die is Stationary

PANGBORN SAND-BLAST HELMET AND AIR WASHER

The all-rubber sand-blast helmet shown in Fig. 2 has been placed on the market by the Pangborn Corporation, Hagerstown, Md. An important advantage claimed for this helmet, which is known as the Type DE, is that it is as simple to repair as a tire tube.

This helmet is designed to protect the lungs as well as the eyes of the wearer. The helmet is equipped with a curved glass window protected by a bulged screen, both of which can be easily replaced.

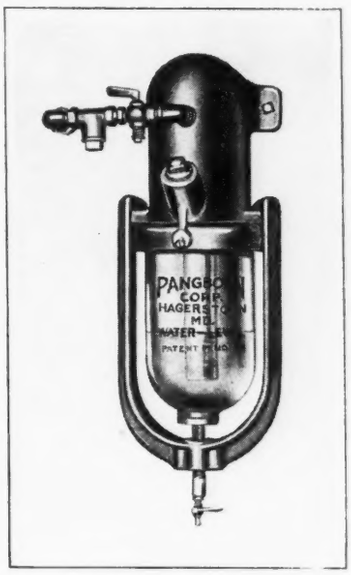
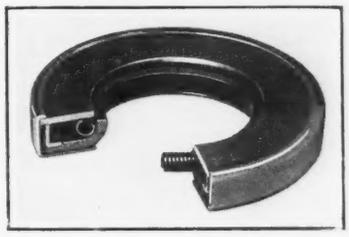


Fig. 1. Device for Supplying Water-washed Air to Sand-blast Helmet

Fresh air at any desired pressure enters through a tube at the back, and is kept in circulation. A fixed air jet above the soft sweat band serves to keep the head cool. Dust is kept from fogging the visor window by directing air on the outside of the visor through small holes immediately above.

In Fig. 1 is shown the Type B air washer recently brought out by this company, which is applicable to the helmet described. This device supplies the helmet wearer with clean water-washed air at practically atmospheric pressure.



Oil-retainer Made by Chicago Rawhide Mfg. Co.

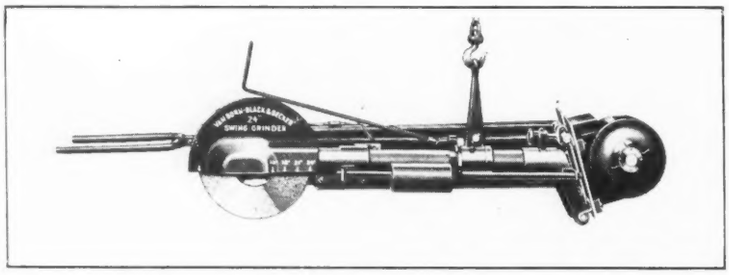
OIL-RETAINING DEVICE

A self-contained, self-aligning device for sealing the lubricant in any rotating shaft bearing in which oil or grease is used has been placed on the market by the Chicago Rawhide Mfg. Co., 1302 Elston Ave., Chicago, Ill. This device, known as the "Perfect oil retainer," is made in assemblies designed to be pressed into a recess by an arbor press with the wiping edge or lip of leather packing pointing in the direction from which the lubricant is to be wiped back.

Contact between the leather packing member and the shaft, spindle, or hub on which it is used is maintained by a specially designed coil spring incorporated in the assembly, as shown in the illustration.

The particular advantages claimed for this oil-retainer are the security with which the leather packing member is locked in place and the self-aligning features. It is made to suit a wide range of shaft sizes from 1/2 to 4 inches.

Fig. 2. Pangborn All-rubber Sand-blast Helmet with Air Washer



Black & Decker Grinder which Increases Spindle Speed when Guard is Adjusted

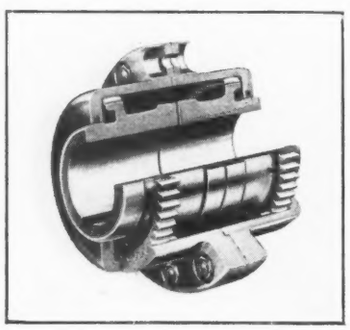
BLACK & DECKER MULTIPLE-SPEED SWING GRINDER

Changes of speed to compensate for wheel wear are accomplished by adjusting the wheel guard on a swing-frame grinder recently brought out by the Black & Decker Mfg. Co., Towson, Md. This grinder has three speed changes. It is available in maximum wheel sizes of 12, 16, 18, 20, and 24 inches in diameter, with primary cutting speeds of 6000 or 9000 surface feet per minute.

A device on the guard makes it possible to tell at a glance whether or not the operator has made the proper guard and speed changes to compensate for wear of the wheel. The grinder is equipped with a heavy ball-bearing motor capable of withstanding 100 per cent momentary overloads without injury.

POOLE MEDIUM-DUTY FLEXIBLE COUPLINGS

Because of the demand for a light- and medium-duty flexible coupling of lower cost than the heavy-duty type, the Poole Engineering & Machine Co., Baltimore, Md., has introduced the medium-duty type here illustrated, which has the same general features as the standard or heavier types. This type is made in three sizes having bores of 1, 1 1/2, and 2 inches in diameter, respectively. The capacities for the three sizes are 3, 8, and 20 horsepower per 100 revolutions per minute. The maximum speed is 7500 revolutions per minute for the 1-inch size, and 6000 and 5000 revolutions per minute, respectively, for the 1 1/2- and 2-inch sizes.



Poole Medium-duty Flexible Coupling

These couplings are intended for drives such as are used for pumps, fans, small compressors, small generators, blowers, ventilators, elevators, and other machines within the range of their power-transmitting capacities. The coupling is designed to permit its members to float freely without subjecting the bearings, shafts, or other parts to strains, and is also designed to compensate for angular as well as offset misalignment. It is oil-tight, and dust- and moisture-proof.

GISHOLT EQUALIZING CHUCK JAWS

The chucking of ring gears or thin-walled parts with a powerful grip, yet without causing excessive distortion, is accomplished by means of hydraulically equalized chuck jaws recently developed by the Gisholt Machine Co., 1201 E. Washington Ave., Madison, Wis. The design of these chuck jaws, on which application for a patent has been made, permits rough or uneven castings to be gripped securely with the clamping pressure uniformly distributed among the hydraulically equalized jaws.

Each jaw of a set contains several pistons, as illustrated in Fig. 1. These pistons are free to move in and out through lapped steel liners. Each of the jaws shown contains four pistons, providing twelve chucking points for gripping the ring gear forging on its inner surface.

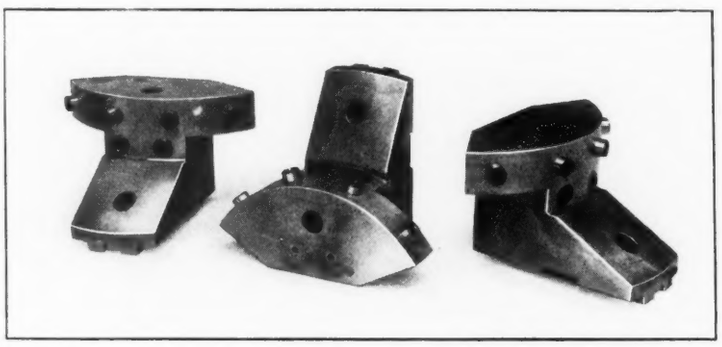


Fig. 1. Set of Three Gisholt Hydraulically Equalized Chuck Jaws

The pistons are backed up by a common body of liquid which

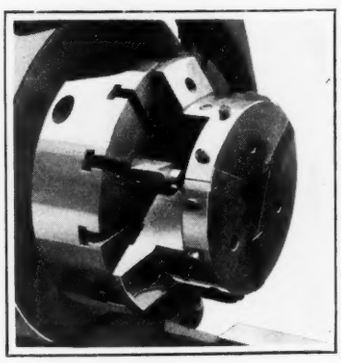


Fig. 2. Chuck Equipped with Gisholt Equalizing Jaws

transmits pressure from one piston to the others, so that when one of the pistons makes contact with a high spot, it will recede into the jaw, forcing the liquid beyond it into the cylinders behind the other pistons. When all the pistons have come into contact with the part being chucked, this cushioned effect ceases, as the liquid is practically incompressible. The pressure behind each piston is then the same, since the areas of the pistons are equal.

These jaws are applicable to two-, three- and four-jaw chucks of almost any type or make, and are built only on special order to suit the customer's specifications.

The chuck with hydraulically equalized jaws shown in Fig. 2 is used for holding a nickel-chromium steel ring gear blank while straddle-facing the two faces and turning the outside within close limits at the rate of 3 3/4 minutes per piece, floor-to-floor time. In this installation, the jaws are used on an 18-inch, three-jaw air chuck.

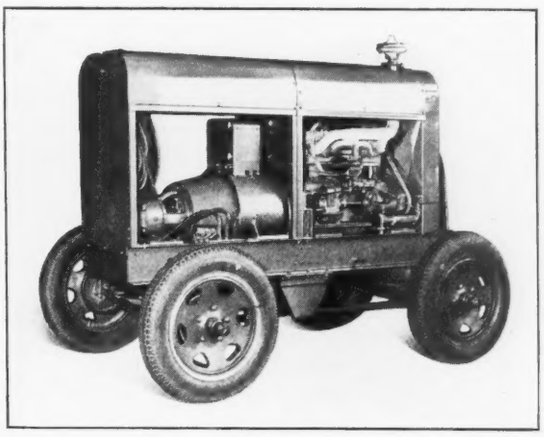
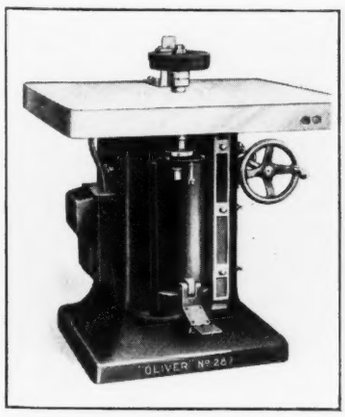


Fig. 1. Westinghouse Portable Gasoline-engine Driven Welder

OLIVER WOOD SHAPER OR VARIETY MOLDER

The single-spindle high-speed wood shaper here illustrated, which is made by the Oliver Machinery Co., Grand Rapids, Mich., is applicable to such wood-working operations as rabbetting, grooving, fluting, routing, or shaping in connection with pattern shops or other wood-working shops. Because of the high spindle speed, which is usually 7200 revolutions per minute, the stock may be fed to the cutters either with or against the grain in a single operation. A detachable spindle is used, and the top is tapered to receive the adapter spindle. The motor drive may be either direct to the spindle or through a belt transmission. The rotating spindle can be stopped quickly by a combination foot-brake and electrical stop.



Oliver Single-spindle High-speed Wood Shaper or Variety Molder

WESTINGHOUSE ELECTRIC WELDERS

The portable 300-ampere, single-operator, FlexArc welder shown in Fig. 1 has been placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., particularly for the use of public utilities, street railways, and other concerns whose work is widely scattered.

The power unit, generator, exciter, and control are all enclosed in a sheet-metal canopy having removable sides. Heavy-duty, pneumatic-tired wheels and spring-supported running gear parts are attached to the welded channel base. An adjustable steering rod for hand or trailer service is provided. The over-all dimensions of the complete unit are 93 by 60 by 72 inches, and the weight is 3200 pounds.

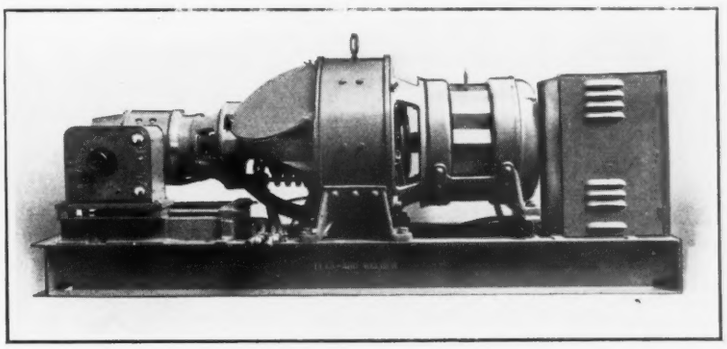


Fig. 2. Welder Designed to Use Large-sized Metallic and Carbon Electrodes

The same company has also brought out the 600-ampere, single-operator, FlexArc motor-driven welder shown in Fig. 2. This welder is designed to handle various sizes of electrodes, including bare and special coated rods requiring current up to 750 amperes. It is available with electric-motor or gasoline-engine drives and also in stationary or portable models.

The motor and generator have a common shaft and a two-bearing exciter overhung from the commutator end of the main generator. The new Westinghouse Flexactor, which provides a non-surge welding circuit and arc stabilization, is mounted on the welded channel base under the exciter. The controls are all enclosed in a sheet-metal cabinet

mounted beside the welding outlet leads. The over-all dimensions of the unit are 96 by 28 by 40 inches, and its weight is approximately 4500 pounds.

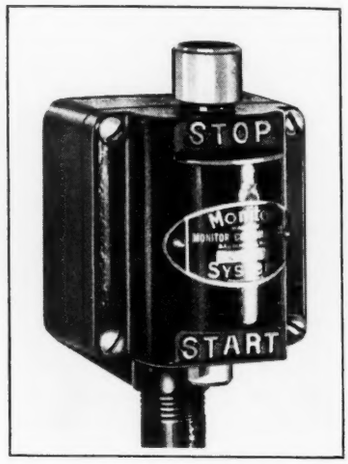
Buffalo Bench Drill Designed for Production Work

BUFFALO HEAVY-DUTY BENCH DRILL

A ten-inch heavy-duty bench drill with a capacity for drilling 1/2-inch holes in cast iron has been developed recently by the Buffalo Forge Co., Buffalo, N. Y. The spindle and pulleys are provided with bronze bearings, and there is a quick return spring on the spindle. A 1/4-horsepower vertical ball-bearing motor, running at a speed of 1725 revolutions per minute, provides three spindle speeds of 3000, 1750, and 850 revolutions per minute. The drive is by a V-belt, and hand-knobs provide for belt adjustment through a rack and pinion. The working surface of the oil-trough table is 7 inches square, the distance from the column to the center of the drill 5 1/8 inches, the maximum distance from chuck to table 11 1/2 inches, and the weight of the drill and motor 105 pounds.

MONITOR "IRONCLAD" PUSH-BUTTON SWITCH

A push-button switch for machines requiring momentary contact control for quick-action "inching" has been added to the products of the Monitor Controller Co., Gay, Lombard, and Frederick Sts., Baltimore, Md. This switch is adapted for either alternating or direct current. The stop-button can be easily operated, and is placed in an accessible position on top of the switch box. The box is 4 1/4 inches high, 2 15/16 inches wide, and 2 5/8 inches deep. The starting button is placed on the lower side of the box, and is fully protected from accidental contact. Special construction is employed to make the switch drip- and splash-proof. Connections can be made at the top, bottom, or either side of the box.



"Ironclad" Starting and Stopping Switch

NEWS OF THE INDUSTRY

BOSTON GEAR WORKS SALES CO., North Quincy, Mass., announces that Doehler die-cast stock gears are now being distributed exclusively by this company under the name of Doehler-Boston die-cast stock gears.

PORTER-CABLE MACHINE CO., Salina and Wolf Sts., Syracuse, N. Y., announces the appointment of Harron, Rickard & McCone Co., 1600 Bryant St., San Francisco, Calif., as northern California representative for Porter-Cable manufacturing lathes.

EX-CELL-O AIRCRAFT & TOOL CORPORATION, 1200 Oakman Blvd., Detroit, Mich., announces that it has established the policy of carrying stocks of Ex-Cell-O products, including drill jig bushings, ground-thread taps, counterbores, etc., in the different branch offices of the company.

J. H. WILLIAMS & CO., Buffalo, N. Y., manufacturers of drop-forgings and drop-forged tools, have recently awarded a contract for an addition to their plant. The extension will provide an increase in floor space of approximately 30,000 square feet, which will be used for additional heat-treating facilities and also for finishing, assembling, and storing the company's standard products.

CHAIN BELT CO., Milwaukee, Wis., announces that the main office, gray iron foundries, and chain manufacturing plants of the company are now located at 1600 W. Bruce St., Milwaukee. The concrete mixer plant, the engineering and conveyor plants, and the malleable foundries have been moved from 39th Ave. and Orchard St. to S. 45th and Orchard Sts.

TINIUS OLSEN TESTING MACHINE CO., 500 N. 12th St., Philadelphia, Pa., has awarded a contract for the erection of a six-story addition to the company's factory to be used for storage and assembling purposes, as well as for an enlarged erecting floor for the erection of extremely large testing and balancing machine equipment. The new addition, completely equipped, will represent an expenditure of approximately $75,000.

BURTON, GRIFFITHS & CO., LTD., Birmingham, England, machine tool dealers selling American machine tools in Great Britain, announce that the firm has transferred its headquarters to Montgomery St., Sparkbrook, Birmingham, England. The company acts as agents for many American firms, including the Landis Tool Co., Kearney & Trecker Corporation, Gisholt Machine Co., Lapointe Machine Tool Co., and Blanchard Machine Co.

CHICAGO PNEUMATIC TOOL CO., 6 E. 44th St., New York City, has just erected a new service station at 570 E. Larned St., Detroit, Mich. The building is of reinforced concrete, two stories and basement, containing approximately 12,000 square feet of floor space. Half of the first floor will serve as a warehouse for compressors, engines, and other heavy machinery, while the other half will house the parts storage, a sound-proof test room, repair bench, shipping and receiving benches, delivery counter, etc. The office occupies half of the second floor, the remainder of the space being devoted to the storage of complete tools.

ONE Screw Machine that Does the Work of TWO

The New No. 00G High Speed

Unusual production possibilities in *both* brass and steel are offered by the New No. 00G Automatic Screw Machine (High Speed) (For Motor Drive Only). With this high speed machine, the maximum production rates in brass are retained and a substantially increased production is obtained on steel parts. In many cases previous rates are doubled.

The variety of spindle speeds available, 30, ranging in practically a geometrical progression from 243 to 5000 R.P.M., makes it possible to produce steel parts as well as those from brass, aluminum and other freely cut materials. These speeds are arranged in ratios of 3 to 1 and 5 to 1, permitting the correct surface speed for threading without sacrificing the most efficient speed for the remaining operations.

Applying steel work to this type of machine takes advantage of high speed features formerly adaptable only to brass and freely cut materials. These include faster feeding of stock, faster indexing of turret, and other high speed features that assist in maintaining maximum production.

By replacing your present equipment on a one for two basis, material savings are accomplished in the investment costs, operating costs, floor space, etc.

Why not determine to what extent you can use this high speed machine on steel as well as brass work? Complete specifications sent upon request, or ask our representative to explain the advantage of the replacement of your obsolete equipment with modern screw machines.

Capacity

Hole through largest feeding finger, 5/16".

Turns any length to 3/4".

One movement of feeding mechanism feeds any length to 1".

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

PERSONALS

JOHN C. PHELPS has become associated with the Universal Gear Corporation, 327 S. La Salle St., Chicago, Ill., in the capacity of sales manager.

C. T. CROCKER has been appointed designing engineer of the aeronautics and marine department of the General Electric Co., Schenectady, N. Y.

H. L. SCHUCK is now associated with the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich., in the capacity of tap expert.

CHARLES W. PENDOCK, president of the Le Roi Co., Milwaukee, Wis., has been elected a director of the Independent Pneumatic Tool Co., Chicago, Ill.

E. L. MILLS, sales manager of the Bastian-Blessing Co., Chicago, Ill., has been elected president of the Gas Products Association, which has headquarters at 608 S. Dearborn St., Chicago, Ill.

W. D. CAMERON has been appointed manager of the Detroit office of the General Electric Co., Schenectady, N. Y., to succeed the late J. H. Livsey. Mr. Cameron has been assistant manager of the Detroit office since 1927.

C. T. DARE has recently been added to the sales organization of the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich. Mr. Dare will make his headquarters at the Dayton office of the company and will cover Indiana and southern Ohio.

AUSTEN BOLAM has recently become associated with the Research Division of the Sherman Corporation, 292 Madison Ave., New York City, business engineers. For the last four years Mr. Bolam has operated his own business as consultant in publicity and market research.

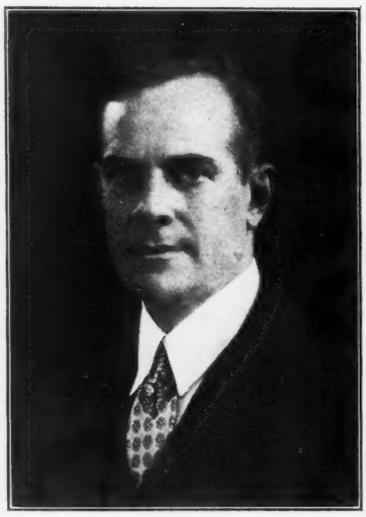
H. B. KILROE has been appointed representative of the Allied Die Casting Corporation, Long Island City, N. Y., for the southern Ohio territory, covering Dayton and Columbus, and including Indianapolis. Mr. Kilroe's headquarters are at 507 Dayton Industries Bldg., Dayton, Ohio.

T. R. SWENSON, for seven years with the sales department of the Danly Machine Specialties, Inc., Chicago, Ill., has just joined the sales department of the Midwestern Tool Co., 2811 N. Ashland Ave., Chicago, Ill., manufacturer of milling cutters, hobs, gages, and special tools of all kinds.

EARLE S. HENNINGSON has been appointed engineer of the alternating-current engineering department of the General Electric Co., Schenectady, N. Y. Mr. Henningson entered the employ of the General Electric Co. immediately upon graduating from the University of Wisconsin in 1912.

ELMER P. GRISMER has been appointed general sales manager of the R. G. Haskins Co., 4634 W. Fulton St., Chicago, Ill., manufacturer of portable electric flexible shaft equipment. L. D. BOWDEN has been appointed sales manager of the newly formed automotive division. Mr. Bowden formerly handled general sales in the Chicago and South Bend territory.

G. VAN DYKE, manager of the special steels department of Joseph T. Ryerson & Son, Inc., Chicago, Ill., has been delivering a number of lectures throughout the country on alloy steels, tool steels, and stainless steels. Recent meetings have been held in Minneapolis, Cincinnati, and Milwaukee, and further meetings are planned for the principal cities throughout the country. The talk and demonstration was originally prepared for Ryerson salesmen and service men. The lecture takes about three hours, and two hours are devoted to practical demonstration and instruction, including welding.



G. Van Dyke

Victor O. Homerberg

VICTOR O. HOMERBERG has been appointed technical director of the Nitralloy Corporation, 52 Broadway, New York City. Mr. Homerberg was formerly associate professor of physical metallurgy at the Massachusetts Institute of Technology. He has also been consulting metallurgist for a number of manufacturing concerns and engaged in research work pertaining to the nitriding process. He is the author of a number of articles pertaining to metallography, and co-author of a text-book on that subject.

W. S. STEWART, formerly in charge of the Pacific Coast offices of the Lincoln Electric Co., manufacturer of arc-welding equipment and electric motors, has been made district manager in charge of the Cleveland territory, with offices at the company's factory, Coit Road and Kirby Ave., Cleveland, Ohio. Mr. Stewart has been in the employ of the Lincoln Electric Co. for many years, both in the factory and in the field.

ALBERT KEUNEY, formerly connected with the Chicago office of the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich., has been transferred to Milwaukee and will have charge of that territory. Mr. Keuney was previously associated with the Studebaker Corporation in Detroit, where he conducted research work on gears and had charge of lay-out work and budgeting of departmental expenses.

C. F. MESSINGER, vice-president of the Chain Belt Co., Milwaukee, Wis., has been elected general manager. H. S. GREENE succeeds Mr. Messinger as general sales manager. BRINTON WELSER, formerly secretary, was elected director and vice-president. J. C. MERWIN was re-elected vice-president. A. R. ABELT was elected secretary of the company, and continues in charge of chain sales. W. H. BRANDT, formerly assistant secretary, becomes assistant to the president.

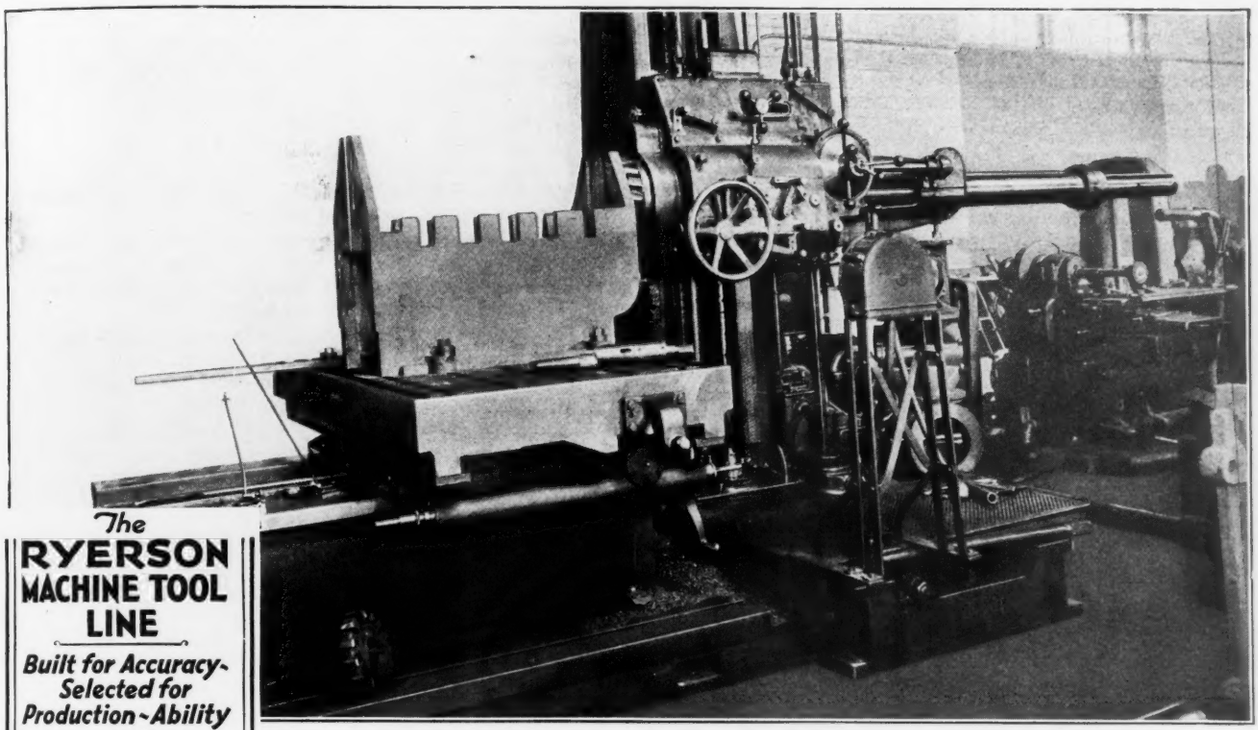
OBITUARIES

EDWARD CONRAD WALDVOGEL, a director and vice-president of the Yale & Towne Mfg. Co., Stamford, Conn., passed away at his residence in New Rochelle, N. Y., on November 13, following an attack of pneumonia. Mr. Waldvogel was born in Toledo, Ohio, and became connected with the Yale & Towne organization in 1905 as a traveling salesman. In 1910, he was transferred to New York as assistant to the general manager, and in 1912 was appointed assistant general manager. He succeeded Walter C. Allen, the present president of the company, as general manager in 1916. In 1920, Mr. Waldvogel was elected a director of the company, and in 1923, was appointed vice-president in charge of the Division of Sales. On April 1, 1930, he retired from active service, but still retained his connection as director and vice-president. He is survived by his wife, two sons, and a daughter.

WILLIAM PIEZ, European correspondent of the Link-Belt Co., and a brother of Charles Piez, chairman of the board, died at Brussels, Belgium, on November 2, after a week's illness. Mr. Piez was born at Newark, N. J., in 1878. Previous to his association with the Link-Belt Co., he was district manager of the Concrete Steel Co., Chicago, Ill. He had been living in Paris since 1928.

OHIO

HORIZONTAL BORING, DRILLING & MILLING MACHINES



Reduces Time More Than 40%—

It used to take 12 hours and 42 minutes floor-to-floor time on the job shown above. Now the Green Bay Barker Machine & Tool Co., Green Bay, Wis., handle the work in 7 hours and 32 minutes on this floor type Ohio Horizontal, equipped with a compound table—a saving of more than 40% in time. The job, facing and cutting slots on all four sides of the grinder pocket (used on paper mill machinery) is quickly and accurately handled by the one machine; set-up is greatly simplified.

Other Ohio Horizontals are showing equally good records both in saving of time and in accuracy of work. Let us send you data on any jobs you are interested in. Ohio Horizontals are built in all standard types and sizes.

THE OHIO MACHINE TOOL CO., KENTON, OHIO

General Distributors

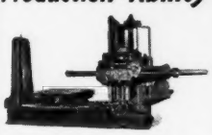
JOSEPH T. RYERSON & SON INC.

OFFICES IN CHICAGO AND OTHER PRINCIPAL CITIES

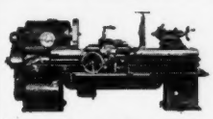
SOLD THROUGH EXCLUSIVE DEALERS

The
RYERSON MACHINE TOOL LINE

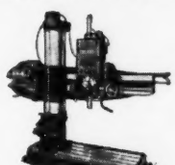
Built for Accuracy-Selected for Production-Ability



Ohio Horizontal Boring, Drilling and Milling Machines



Monotrol and Tritrol Lathes



Dreses Radial Drills

Ohio Shapers and Planers

RYERSON
Machinery Division
General Distributors
Machine Tools

Structural and Plate Working Equipment, Sheet Metal Tools —Welders, Railroad Shop Machinery, Small Tools, etc.

COMING EVENTS

DECEMBER 1-6 — Ninth National Exposition of Power and Mechanical Engineering in the Grand Central Palace, New York City.

DECEMBER 1-6—Fifty-first annual meeting of the American Society of Mechanical Engineers in the Engineering Societies Building, New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JANUARY 19-23 — Annual meeting of the Society of Automotive Engineers at the Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary, 29 W. 39th St., New York.

FEBRUARY 16-20—Second National Western Metal Congress and Exposition to be held in the Civic Auditorium, San Francisco, Calif., under the auspices of the American Society for Steel Treating. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

APRIL 13-18—Second National Industrial Equipment Exposition at the Public Auditorium in Cleveland, Ohio. Managing director, G. E. Pfisterer, 308 W. Washington St., Chicago, Ill.

MAY 4-8—Annual meeting of the American Foundrymen's Association at the Stevens Hotel, Chicago, Ill. A limited exhibit of foundry equipment and supplies will be held in conjunction with the meeting.

JUNE 5-6 — Annual convention of the National Association of Foremen at Dayton, Ohio. E. H. Tingley, secretary, U. B. Building, Dayton, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

WORCESTER POLYTECHNIC INSTITUTE, Worcester, Mass. Catalogue for 1930-1931, containing calendar, outline of courses, and other matter relating to the Institute.

NEW BOOKS AND PUBLICATIONS

HAND TOOL ACCIDENTS—THEIR CAUSE AND PREVENTION. 46 pages, 6 by 9 inches. Published by the Department of Labor of the State of New York, Albany, N. Y.

BUDGETING MANUFACTURING OPERATIONS. 38 pages, 7 3/4 by 10 3/4 inches. Published by the Policyholders' Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City.

CUTTING TESTS WITH CEMENTED-TUNGSTEN-CARBIDE LATHE TOOLS. By T. G. Digges. Research Paper No. 206 of the Bureau of Standards, Washington, D. C. 19 pages, 6 by 9 inches. Published by the Government Printing Office, Washington, D. C. Price, 10 cents.

KNOW THE FORD. By Murray Fahnestock. 96 pages, 9 by 12 inches; 160 illustrations. Published by the Ford Dealer and Service Field Magazine, Milwaukee, Wis. Price, $2.

This book covers in considerable detail the various mechanisms of the Ford car. It should prove of value to owners of Ford cars, as well as to service and repair shops.

NEMA MOTOR AND GENERATOR STANDARDS. 132 pages, 7 3/4 by 10 1/2 inches. Published by the National Electrical Manufacturers' Association, 420 Lexington Ave., New York City. Price, $1.50.

Those concerned with the selection, installation, and operation of motors and generators will find this new book on motor and generator standards of interest. It contains information on application and selection, ratings, tests, performance, construction, guarantees, and business policies, as well as comprehensive lists of definitions and abbreviations of terms pertaining to motors and generators.

A. S. T. M. TENTATIVE STANDARDS FOR 1930. 864 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Price, paper-bound, $7; cloth-bound, $8.

This book contains 155 tentative standards and recommended practices proposed by the Society, covering ferrous and non-ferrous metals; cement, lime, gypsum, and clay products; preservative coatings and petroleum products; road and paving materials; rubber products, insulating materials, and textile materials; coal and coke, shipping containers, slate, and miscellaneous materials.

THE UNITED KINGDOM — AN INDUSTRIAL, COMMERCIAL, AND FINANCIAL HANDBOOK. 953 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Trade Promotion Series No. 94 of the Bureau of Foreign and Domestic Commerce. Price, $1.75.

This is a voluminous report on the industrial, commercial, and financial conditions in Great Britain, and will undoubtedly be of interest to business men who are desirous of cultivating trade in that market. The parts of particular interest to the machinery industries are Chapter 7, dealing with iron and steel and non-ferrous metals, and Chapter 8, treating of industrial equipment, including machine tools. Of more general interest are Chapter 27, explaining how to do business in Great Britain, Chapter 28, dealing with the tariff situation, and Chapter 29, discussing the legal situation.

ELEMENTS OF MECHANISM. By Peter Schwamb, Allyne L. Merrill, and Walter H. James. 372 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $3.50.

This is the fourth edition of a book treating of the elements of mechanism, which is intended primarily to familiarize the student with the fundamental principles of physics and simple mathematics in the specific field of mechanical movements. The purpose is not to describe a large number of different devices, but to select the relatively more common and fundamental machine elements and study their motions when combined in certain definite ways. The present edition follows very closely the text of the previous one, but embodies a number of minor changes in arrangement, content, and method of treatment, in accordance with suggestions offered by professors in a number of institutions using the book. One of the changes is the insertion at the end of each chapter of problems for solution by the student.

THOMAS' REGISTER OF AMERICAN MANUFACTURERS. 4600 pages, 9 by 12 inches. Published by the Thomas Publishing Co., 461 Eighth Ave., New York City. Price, $15.

This is the twenty-first edition of a well-known reference guide for buyers covering all classes of American manufactured products. The first section comprises an index or finding list covering 185 pages, and is printed on yellow paper so that it can be easily found. The second or main section of the book (3619 pages) consists of a classified directory of the various manufactured products, arranged alphabetically. The manufacturers' names and addresses are given according to geographical location. The third section contains an alphabetical list of manufacturers, including in many cases, home offices, branch offices, subsidiaries, successors, etc. This is printed on blue paper. The last section of the book, printed on pink paper, contains a list of the leading trade names of the various products covered in the directory, including the names and addresses of the manufacturers. An appendix gives lists of banks, boards of trade, and leading trade papers. This book should prove of great value to executives, purchasing departments, and sales departments as a guide to sources of supply and a means of compiling lists of names for both buying and selling.

NEW CATALOGUES AND CIRCULARS

COLLAPSIBLE TAPS. Rickert-Shafer Co., Erie, Pa. Bulletin CT, containing data on Rickert-Shafer collapsible taps of the stationary and revolving types.

ROTARY FILING MACHINE. Rehnberg-Jacobson Mfg. Co., Rockford, Ill. Circular illustrating and describing the company's Model A rotary filing machine.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Engineering data sheets Nos. 9 to 26, inclusive, covering details relating to various types of ball bearings.

STEEL. Republic Steel Corporation, Youngstown, Ohio. Circular containing a reprint from the *Saturday Evening Post*, descriptive of the service offered by this company.

GEARS. Boston Gear Works Sales Co., North Quincy, Mass. Catalogue covering Doehler-Boston die-cast stock gears, including spur gears, spiral gears, and bevel gears.

LOCK-WASHERS. Shakeproof Lock Washer Co., 2501 N. Keeler Ave., Chicago, Ill. General reference sheet for Shakeproof lock-washers and locking terminals, giving nominal sizes of the different types.

ELECTRIC MOTORS. Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio. Bulletin 109, illustrating and describing Type AA induction motors with ball bearings for two- and three-phase alternating-current circuits.

NICKEL ALLOY STEEL PRODUCTS. International Nickel Co., Inc., 67 Wall St., New York City. Buyer's Guide for 1930, comprising a directory of manufacturers, fabricators and distributors of nickel alloy steel products.

NICKEL STEEL. International Nickel Co., Inc., 67 Wall St., New York City. Bulletin 1-A of a series dealing with nickel steel data and applications, giving standard specifications for steels adopted by the Society of Automotive Engineers.

PLATING BARRELS. Hanson-Van Winkle-Munning Co., Matawan, N. J. Bulletin M-104, illustrating and describing Hanson-Munning plating barrels of the Mercil type. A standard equipment chart covering the various types and sizes is included.

FORMING AND THREADING MACHINES. Landis Machine Co., Inc., Waynesboro, Pa. Bulletin E-70, illustrating and describing in detail the features of construction of Landis 3/4-inch and 1-inch automatic forming and threading machines.

GRINDING MACHINES. Churchill Machine Tool Co., Ltd., Broadheath near Manchester, England. Leaflets covering open-side surface grinding machines, crankshaft regrinding machines, automobile brake-drum grinders, and car-wheel tire grinders.

MILLING CUTTERS. O. K. Tool Co., Inc., Shelton, Conn. Circular entitled "Grinding O. K. Cutters," comprising a treatise on the grinding of inserted-blade milling cutters, boring or facing heads, hollow mills, etc. Information is also given on the assembly of O. K. cutters.

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AN *all-around Jig in itself, for a wide variety of jobs, thus saving the cost of many special jigs which would be useless for other work when their purpose had been served. If the quantity of your work warrants such special jigs, originate them on the "Precision."*

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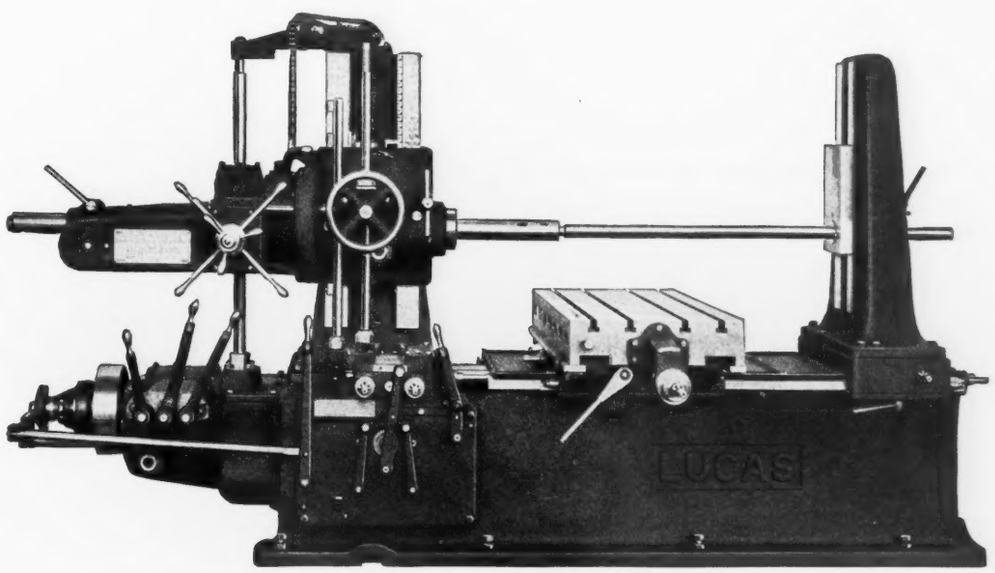

THE LUCAS MACHINE TOOL CO., Cleveland, O., U.S.A.

FOREIGN AGENTS: Catmur Machine Tool Corp., Ltd., London. Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

CUTTER GRINDERS. Cincinnati Milling Machine Co., Cincinnati, Ohio. Booklet entitled "Facts on Features," describing the No. 2 Cincinnati cutter grinder, both plain and universal. Performance figures and an investment analysis of the machines are also given.

MILLING MACHINES. Ingersoll Milling Machine Co., Rockford, Ill. Circular entitled "Machining Dies with Ingersolls," illustrating and describing the application of Ingersoll milling machines to the machining of die blanks, as well as Ingersoll machines for die-sinking.

SPEED REDUCERS. Foote Bros. Gear & Machine Co., 111 N. Canal St., Chicago, Ill. Catalogue 102, containing data on IXL Titan herringbone or helical speed reducers for heavy-duty drives. Complete information, ratios, ratings, prices, and dimensions are included.

GEARS. American Die & Tool Co., 205 Buttonwood St., Reading, Pa. Catalogue illustrating and describing Adtco precision and special gears. Typical examples of the classes of gears produced are shown, including airplane engine gears, automotive, marine, and industrial gears.

PIPE THREADING AND CUTTING DIES. Borden Co., Warren, Ohio. Bulletin illustrating and describing nine new Beaver pipe tools which have recently been developed by this company. The circular also illustrates the Beaver power drive, with universal motor, for pipe-threading dies.

CONVEYORS. Mathews Conveyer Co., Ellwood City, Pa. Circular illustrating and describing the Mathews improved heavy-duty ball-bearing roller-conveyor, in which new features are incorporated for the purpose of giving it greater strength, longer life, and better protection against dust and dirt.

POWER TRANSMISSION AND CONVEYING CHAIN. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Booklet entitled "Promal Chains," illustrating, describing, and listing a new type of chain brought out by the company, made from a new metal for cast chains, the characteristic of which is strength and long life.

GRINDING MACHINES. Churchill Machine Tool Co., Ltd., Broadheath, Manchester, England. Catalogue entitled "Precision Grinding in the Railway Shop," illustrating and describing the use of Churchill precision grinding machines on various classes of railway work. Specifications for the different types and sizes are also given.

WIRE-WORKING MACHINERY. Baird Machine Co., Bridgeport, Conn. Circular showing a battery of Baird automatic forming machines in use in the plant of the RCA Radiotron Co. The circular also shows other Baird products, including tilting tumblers, ball burnishing barrels, and automatic multiple-spindle lathes.

SHEET-METAL WORKING MACHINES. Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. Bulletin illustrating and describing Niagara electric combination machines for performing sheet-metal operations; slip roll formers; squaring shears; combination bench machines; and crimpers and beaders.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Circulars GEA-37F, 132, 529A, 1174B, 1177B, and 1324, illustrating and describing, respectively, direct-heat electric furnaces; phase protective panels; low-speed synchronous motors; conveyor furnaces; oil immersion heaters for aircraft engines; and air-draw furnaces.

PLATING AND POLISHING EQUIPMENT. Crown Rheostat & Supply Co., Chicago, Ill. Catalogue containing data on equipment and supplies for plating and polishing. Information is also given on the operation of modern plating and polishing departments, as well as tables and formulas useful to those engaged in this class of work.

FASTENING METHODS. Parker-Kalon Corporation, 200 Varick St., New York City. Booklet containing a record of studies of fastening methods used by several leading manufacturers in the metal-working industries. Mention is made of specific economies effected by the use of hardened self-tapping sheet-metal screws and hardened metallic drive screws.

ROLLER BEARINGS. Shafer Bearing Corporation, 6501-99 W. Grand Ave., Chicago, Ill. Circular illustrating and describing Shafer self-aligning roller bearing units for industrial and machine applications. Tables of dimensions and prices are given for hanger boxes, pillow blocks, baseplates, duplex units, cartridge units, flange bearings, take-up bearings, and conveyor rolls. A table of load ratings is included.

METAL CLEANING. Magnus Chemical Co., 19 South Ave., Garwood, N. J. Instruction book entitled "The Cleaning of Metal," covering the processes, methods, and materials used, together with practical suggestions for their application. This book is actually a text-book of seventy-six 6- by 9-inch pages, prepared especially for this purpose by Dr. Robert W. Mitchell, which covers in great detail this important subject.

MILLING MACHINES. Cincinnati Milling Machine Co., Cincinnati, Ohio. Booklet entitled "Facts on Features," dealing with the company's Hydromatics provided with locked hydraulic feed. Another booklet with the same title deals with the features of the No. 2, No. 3, and No. 4 plain and universal, and the No. 2 and No. 3 vertical Cincinnati milling machines. The booklets give performance figures and an investment analysis of the machines covered.

POWER PRESSES. Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. General catalogue covering the complete line of power presses made by this concern, which includes single- and double-acting crank presses; cam presses; multiple plunger presses; knuckle-joint or toggle presses; foot and screw presses; shearing presses and slitters; press attachments; and thread-rolling machines. The book is divided into various sections according to the type of machine and is indexed to make reference to any type easy.

DIE-HEADS. Landis Machine Co., Inc., Waynesboro, Pa. Bulletin H-76, descriptive of the construction of Lanco die-heads for automatic, semi-automatic, and hand-operated threading machines. The bulletin shows both the standard head and the internally tripped head. Bulletin C-63, descriptive of the important features of Landis stationary pipe, casing, drill pipe, line pipe and tubing die-heads for pipe threading, and cutting machines. Table of specifications, diagrams of clearances, and attaching charts are included.

ELECTRIC EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. General catalogue 1931-1932, containing 1352 pages, covering the complete line of products manufactured by this company. The book lists distribution apparatus, switch gear apparatus, lighting equipment, domestic appliances, gearing apparatus, current collecting devices, industrial motors and control apparatus, industrial heating apparatus, etc. It is provided with a thumb index for convenient reference to the various sections, as well as a complete alphabetical subject index, a style number index, and a condensed index to products.

CRANES. Whiting Corporation, Harvey, Ill. Handbook of crane information. The material in this book is divided into eighteen sections, dealing with the following subjects: How to Select a Crane; Duty Classification of All Types of Cranes; Standard Clearances for Overhead Electric Traveling Cranes; Average Range of Speeds for All Classes of Duty; Duty Cycle Analysis; Runways for Overhead Traveling Cranes; Crane Bridges; Crane Trolleys; Bucket-handling Cranes; Gantry Cranes; Hand Power Traveling Cranes; Jib, Pillar, and Bracket Cranes; Lifting Attachments for Cranes; Electrical Equipment for Overhead Traveling Cranes; Crane Erection; Crane Lubrication; Typical Crane Specifications; and Crane Safety Features.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for October 1, 1930.

State of New York } ss.
County of New York }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of The Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, Robert B. Luchars, Vice-President, 140-148 Lafayette St., New York, and Edgar A. Becker, Treasurer, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 17th day of September, 1930.

CHARLES P. ABEL,
Notary Public, Kings County No. 228
(SEAL) Kings Register No. 1038
New York County No. 35, New York Register No. 1-A-25
(My commission expires March 30, 1931)